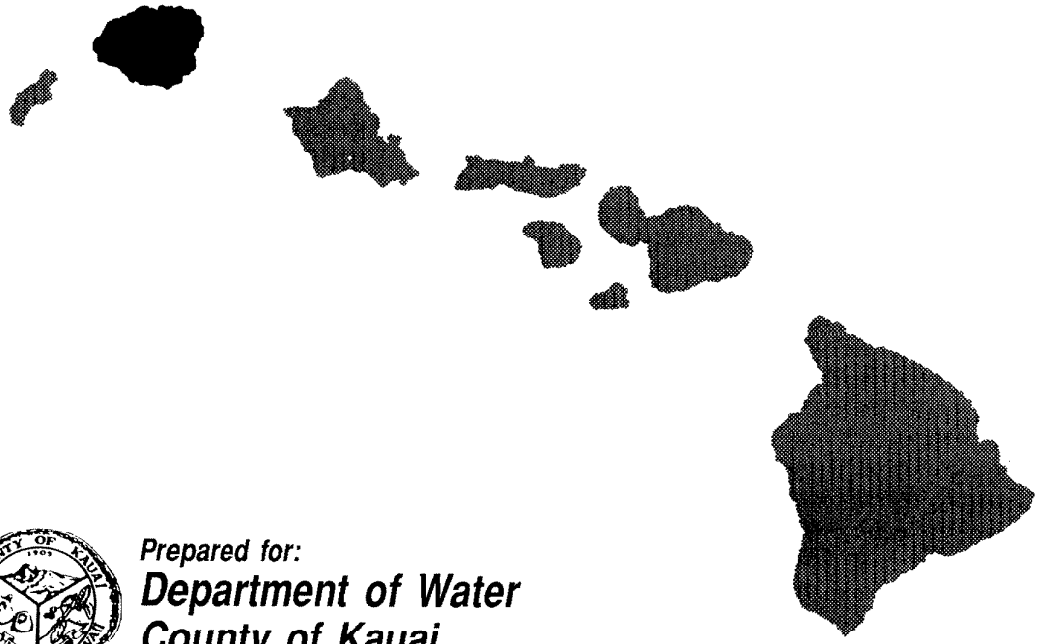
HAWAII WATER PLAN

KAUAI WATER USE AND DEVELOPMENT PLAN



Prepared for:
Department of Water
County of Kauai

By:
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Commission on Water Resource Management
Department of Land and Natural Resources
State of Hawaii

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JOHN WAIHEE
Governor

DEPARTMENT OF LAND AND NATURAL RESOURCES

COMMISSION ON WATER RESOURCE MANAGEMENT

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COUNTY OF KAUAI

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Preface

In 1987, the State Legislature passed the State Water Code (HRS Chapter 174C) to protect and manage Hawaii's surface and ground water resources. Part III of the State Water Code calls for the formulation of a Hawaii Water Plan, an integrated program for the protection, conservation, and management of the waters of the State. The **Kauai Water Use and Development Plan** is one of seven subplans which collectively comprise the Hawaii Water Plan.

The Kauai Water Use and Development Plan, adopted by Kauai County ordinance and endorsed by the Mayor on April 27, 1990, will serve as a continuing long-range guide for water resource development in the County.

On June 27, 1990, the State Commission on Water Resource Management accepted the Kauai Water Use and Development Plan for incorporation into the Hawaii Water Plan, with the following stipulations:

(1) The Water Use and Development Plan (WUDP) will be reviewed and revised by the County and resubmitted to the Commission by July 1, 1991. The Commission would provide the County with supplemental assistance funds for this initial plan revision period. Thereafter, because the WUDP obtains its primary directions from the Hawaii Water Plan, periodic plan reviews and revisions, at the County's expense, will be timed to coincide with the review process of the Hawaii Water Plan.

(2) Amendments to the County's WUDP are to be adopted by ordinance and transmitted to the Commission within ten working days from their date of adoption for review, acceptance, and incorporation into the Hawaii Water Plan.

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INTRODUCTION AND SUMMARY

In 1978, the State of Hawaii Constitution was amended to mandate that "the State has an obligation to protect, control, and regulate the use of Hawaii's water resources for the benefit of its people." The State Water Code was enacted by the Legislature as Act 45, Session Laws of Hawaii 1987.

One of the primary policies of the State Water Code is the need for a program of comprehensive water resources planning to address the problems of supply and conservation of water. The Hawaii Water Plan is intended to fulfill this comprehensive planning requirement through four component parts: a water resource protection plan, water use and development plans for each County, a water projects plan, and a water quality plan. As one of the component plans, the Kauai Water Use and Development Plan is intended to set forth the water use and development planning considerations for the County of Kauai.

The Kauai Water Use and Development Plan shall be adopted by reference when the Ordinance is adopted by the County Council.

The Island of Kauai has an adequate supply of water to meet the projected demands of the County up to and beyond the year 2010. This includes domestic, commercial, industrial and agricultural water demands. The de-facto population of Kauai is projected to grow from 70,100 (51,800 residents) in 1990 to 124,500 (86,900 residents) by the year 2010 by the State of Hawaii Department of Business and Economic Development. Long range water demands, beyond the year 2010, based on General Plan considerations have also been estimated and are presented in this Executive Summary and in the main report.

The State Water Code requires that all existing and projected water use and withdrawals be reported according to areas called hydrologic units. Water use refers to the water actually consumed for domestic, commercial, industrial or agricultural activities. Water withdrawn refers to water taken from a hydrologic unit for use, by wells, tunnels and stream diversions. In this way, water used and withdrawn can be compared to the sustainable yields estimated by the State Water Resources Protection Plan.

The sustainable yield is the estimated amount of water that can be safely withdrawn from a hydrologic unit. The sustainable yields used in this report are preliminary estimates that can give an order of magnitude of the actual sustainable yield of the given hydrologic units. A hydrologic unit with a lower sustainable yield than water withdrawal does not necessarily indicate that the hydrologic unit is being compromised or overdrawn. This condition would indicate a need for further study in the ongoing program of the State Water Plan. The Water Use and Development Plan and the State Water Plan will be amended as additional information becomes available.

All hydrologic units on Kauai have adequate sustainable yields for groundwater, according to the Water Resources Protection Plan, except for Kekaha. Well tests indicate that a problem does not exist at this time. The discrepancy between the estimated sustainable yield and actual field experience is a function of the limited hydrologic information available upon which the sustainable yield estimates were based. Also, the water pumpage reported by the sugar company in Kekaha includes some non-potable water. Additional hydrologic studies should be conducted to clear up this discrepancy. The Waimea, Makaweli, and Hanapepe hydrologic units show an inadequate sustainable yield when compared to surface water withdrawn. Since the sugar plantations adjust their irrigation practices to match the water available, this is not expected to be a problem. The sustainable yield estimates for surface water are very approximate and more studies need to be done to refine these estimates.

The present Water Master Plan has identified many well sites which can be developed to meet the projected potable water needs of Kauai to the year 2010. Additional information has been developed since the Master Plan was prepared and other well sites have been found. A program of well exploration will have to be undertaken in the Hanamaulu, Wailua, Anahola and Waimea hydrologic units to find additional well sites for water development beyond the year 2010. The hydrologic units have the sustainable yields to meet the projected long range needs of Kauai so the primary problem is one of source development. The water is there but the DOW must develop the wells before it can be used. A water source and storage program costing up to $94,000,000 will be necessary to meet the projected needs to the year 2010.

While the areas with discrepancies in sustainable yields to withdrawals should be studied, the high priority areas for further study should be those areas where high growth is projected. It is recommended that these areas be Koloa-Poipu (Koloa hydrologic unit), Lihue (Hanamaulu hydrologic unit) and Kawaihau (Anahola hydrologic unit). The areas next in importance should be the Kekaha, Hanapepe, Waimea and Makaweli hydrologic units.

PLANNING

The County of Kauai has a land area of 357,248 acres, the fourth largest island in the Hawaiian chain. The Island of Kauai comprises less than 10 percent of the land area of the State of Hawaii. Kauai had an estimated resident population of 47,600 in 1987.

Hawaii's water resources vary greatly between islands as well as within each island. There are perennial streams and flash streams, rain forests and cactus deserts. There are groundwater tunnels high in the mountains and low near sea level.

The County of Kauai has a growing economy based on the sugar industry and tourism. Provisional estimates for 1987 indicate a State of Hawaii resident population of 1,082,500 of which 47,400 or approximately 4 percent are in the County of Kauai.

According to the County of Kauai's Office of Economic Development, 1987 resident population figures for the five district areas on Kauai were: Waimea District - 8,907; Koloa District - 11,056; Lihue District - 9,726; Kawaihau District - 13,002; Hanalei District - 4,709.

The major economic forces in the County of Kauai, as well as for the State of Hawaii, are tourism, construction, the military, agriculture, and manufacturing.

The three major determinants of land use in the County of Kauai are the State Land Use District Classifications, the County General Plan and the County of Kauai's Land Use Ordinance (zoning codes), which implements the General Plan. The County of Kauai is divided into five districts; Waimea-Kekaha, Koloa, Lihue, Kawaihau and Hanalei.

The State Land Use for the Island of Kauai includes; 12,391 acres or 4 percent of the land in the Urban District, 141,544 acres or 45 percent of the land in Agricultural Land Use District, 198,732 acres or 56 percent of the land in Conservation Land Use District and 1,233 acres or less than half a percent in a Rural Land Use District.

The County's land use regulation system is headed by the General Plan which currently designates specific types of uses for all parcels. The types of uses, called General Plan Land Use Designations, distinguish between specific urban uses such as commercial, industrial, multi-family residential and single-family residential, and non-urban uses such as agriculture and open. To implement General Plan Land Use Designations, zoning is required.

The estimated acreage of the basic land use units for the General Plan are:

PF	Public Facilities	3,800 acres
R	Resort	2,860 acres
UMU	Urban Mixed Use	3,360 acres
UR	Urban Residential	7,520 acres
RR	Rural Residential	2,100 acres

Note: The other areas are in Open, Agricultural and Conservation lands.

The Kauai Comprehensive Zoning Ordinance provides development and design standards for the location, height and size of structures, yard areas, off-street parking facilities, and open spaces, and the use of structures and open spaces, and the use of structures and land for agriculture, industry, business, residences or other purposes. Table 1 shows the acreage for the basic zoning districts by planning area.

The State Department of Business and Economic Development (DBED) M-K projections anticipate that the resident population of the County of Kauai will rise 86 percent from 45,400 in 1985 to 86,900 in 2010. The de facto population of the County of Kauai which includes visitors, is expected to increase 121 percent from 56,200 in 1985 to approximately 124,500 in 2010. Table 2 shows the projected increase in population from 1990 to 2010 and the areal distribution of the population in 2010, based upon zoning.

The two major economic forces in the County of Kauai, as well as in the State of Hawaii, will continue to be tourism, and agriculture, primarily sugar exports. Tourism, as in the past, will continue to be a leading economic force in Hawaii. The primary resort area on Kauai will continue to be the Koloa-Poipu area with an increase in development in the Princeville area.

TABLE 1

KAUAI WATER USE DEVELOPMENT PLAN
COMPREHENSIVE ZONING ORDINANCE

Zoning Designation	ACRES ZONED FOR PLANNING AREA						
	Hanalei-North-Shore	Kapaa-Wailua	Lihue	Koloa-Poipu-Kalaheo	Hanapepe-Eleele	Waimea-Kekaha	TOTAL
Residential	803.7	1994.5	870.5	2041.6	385.7	676.3	6772.3
Resort	99.1	104.0	92.0	84.1	0.0	0.0	379.2
Commercial	72.7	65.3	273.2	72.8	47.8	27.6	559.4
Industrial	5.1	40.7	205.6	0.0	34.2	26.1	311.7
Project District - Cultural	0	0.0	0.0	12.3	0.0	1.4	13.7
	980.6	2204.5	1441.3	2210.8	467.7	731.4	8036.3

Note: The Open and Agricultural Zoning are not included in this analysis.

TABLE 2

Kauai Water Use and Development Plan
POPULATION PROJECTIONS

YEAR	(1) RESIDENT	VISITOR	(2) DEFACTO
1990	51,800	18,300	70,100
1995	59,500	22,200	81,700
2000	67,900	26,100	94,000
2005	76,800	28,000	104,800
2010	86,900	37,600	124,500

AREAL POPULATION DISTRIBUTION (2010) BY ZONING

AREA	(1) RESIDENT	VISITOR	TOTAL
HANAPEPE, WAIMEA	11,300	527	11,827
KOLOA	19,970	12,390	32,360
LIHUE	20,860	8,542	29,402
KAWAIHAU	22,600	8,309	30,909
HANALEI	12,170	7,833	20,003

AREAL POPULATION DISTRIBUTION (2010) BY GENERAL PLAN

AREA	(1) RESIDENT	VISITOR	TOTAL
HANAPEPE, WAIMEA	15,909	1,666	17,575
KOLOA	27,916	8,799	36,715
LIHUE	16,882	7,417	24,299
KAWAIHAU	22,165	5,840	28,005
HANALEI	4,027	13,878	17,905

1 KAUAI DEPARTMENT OF ECONOMIC DEVELOPMENT
2 HAWAII STATE DATA BOOK

EXISTING WATER USE AND DEVELOPMENT

The major users of Kauai water include the sugar plantations, the Kauai Department of Water (DOW), private industry, diversified agriculture, and other private users who develop water for their own consumption. The DOW is the major supplier of potable water for nearly all residential and urbanized uses on Kauai. Table 3 shows the estimated amount of water used on Kauai in 1988. Figure 3 shows the existing water use and well capacities by water system.

The sustainable yields represent an estimate of the rate of total pumpage which could be continuously withdrawn from an aquifer without affecting either the quality or quantity of the output. Sustainable yields are derived from predevelopment water balances and groundwater behavior over a period of time, and are only estimates to be used as general guidelines at this time. Predevelopment refers to the hydrologic conditions of the Island of Kauai before the introduction of urbanization and agricultural activities. Thus, the impacts of agricultural transport of water and aquifer recharge due to irrigation practices have yet to be taken into account. These estimates will have to be updated in later studies as more hydrologic information is developed for the Island of Kauai. The present estimates can give an order of magnitude of sustainable yield of the given hydrologic unit. A negative discrepancy between sustainable yield and water withdrawal in a hydrologic unit would indicate that the area should require a higher priority further study.

A water balance analysis was used to estimate the sustainable yields used in the State Water Resources Protection Plan. A balance was established between the only source of water in a hydrologic unit, rain, and the water leaving the hydrologic unit. Water leaves the hydrologic unit by evaporation, consumption by plants or transpiration and runoff from streams and rivers. The remaining portion of the rain water percolates into the ground where it can recharge the various types of groundwater aquifers. Of this amount that percolates into the ground, a portion is available for consumption. This portion available for consumption is the sustainable yield for groundwater.

Some groundwater will reappear as surface water, such as springs, which increases the total amount of surface water in rivers and streams. This interaction between surface and ground water makes it more difficult to determine the sustainable yield for surface water. The surface water estimates in this report are very approximate. The consumption of water by man through wells, tunnels and stream diversions for domestic, industrial, commercial and agricultural uses changes the natural hydrologic patterns used in the sustainable yield estimates. Irrigation practices divert water that would normally have flowed to the ocean and place it on crop fields, a portion of which percolates back into the ground to recharge the groundwater aquifers. This will affect the sustainable yield estimates. Additional studies will have to be done to take these factors into account.

Of the total of 388 mgd groundwater sustainable yield islandwide, an estimated 60 mgd was withdrawn in 1988. This leaves a remainder of 328 mgd of available groundwater supply to accommodate future demands. Within individual aquifers, however, there is

TABLE 3

WATER USE ON KAUAI
1988

	Quantity (mgd)	Percent
Board of Water Supply (1)	10.5	2.5
Sugarcane Plantations (2)	355.2	84.0
Private Use & Industrial (3)	57.7	13.5
	423.4	100

(1) DOW records, includes Princeville water use
(2) DOWALD and sugar companies
(3) DOWALD and miscellaneous sources. Includes unverified data from State water registration forms.

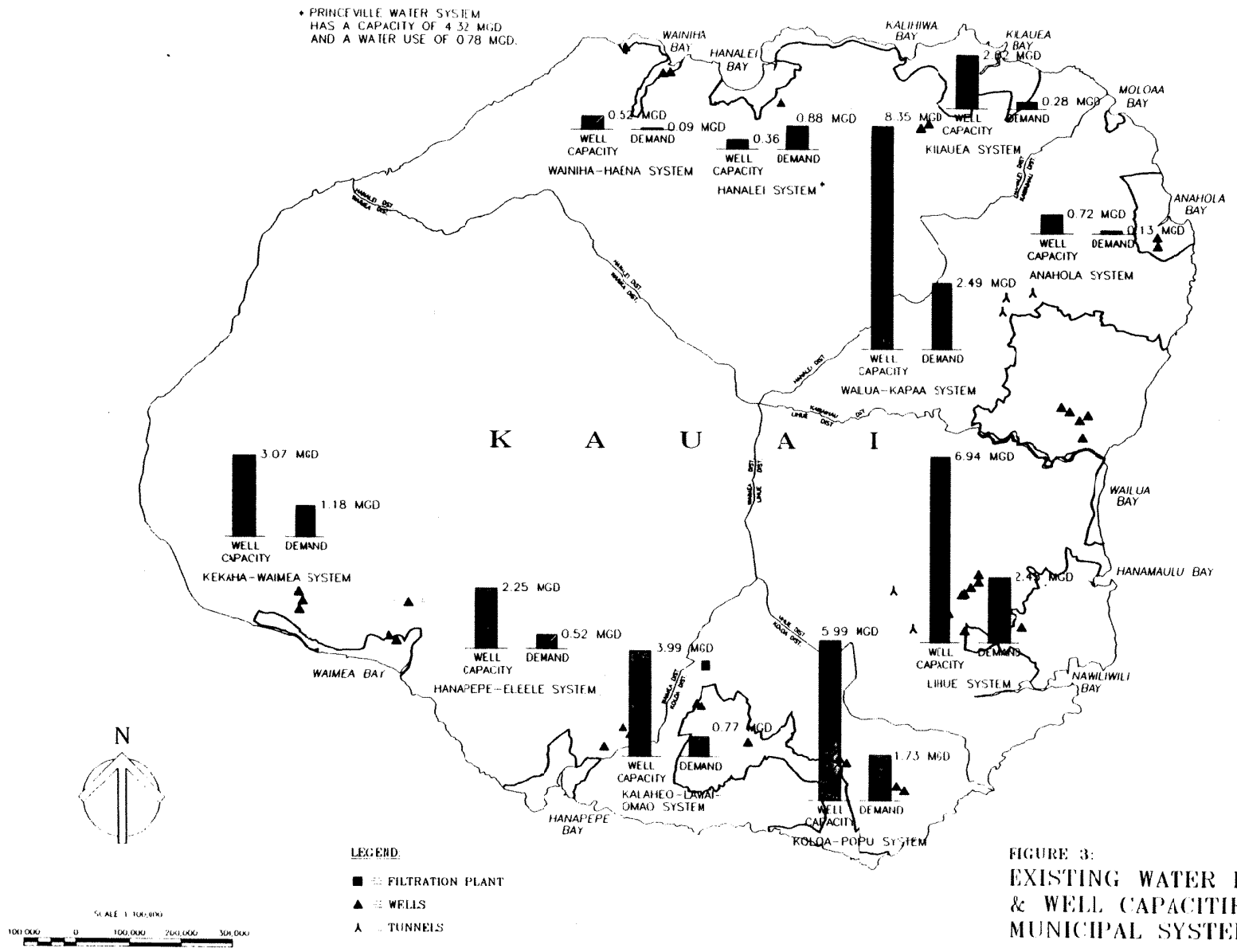

FIGURE 3:
EXISTING WATER DEMAND & WELL CAPACITIES PER MUNICIPAL SYSTEM

substantial variation with one aquifer having a significant withdrawal over sustainable yield. The Kekaha aquifer is estimated to be overdrawn by 7.52 mgd for groundwater but all other aquifers show significant surplus. The estimated overdraft of 7.52 mgd is not occurring at this time based on actual experience. The estimate indicates that the area should have a high priority for further study but there is no indication that the aquifer is being compromised or overdrawn at this time. The Waimea, Makaweli and Hanapepe hydrologic units show an overdraft for surface water which would also indicate the need for further study. Since the sugar companies adjust their irrigation practices to the water available, this is not considered to be a problem.

Agricultural users of water on Kauai consist primarily of plantation irrigation of sugarcane fields. Other diversified agricultural pursuits use a considerable amount of water (including taro, macadamia and other vegetables, coffee, melons, and fruits). The largest use of water on Kauai is for the irrigation of sugarcane plantations. The plantation companies utilized approximately 355.2 mgd for irrigated sugarcane, about 99 percent of all surface water utilized in 1988 on Kauai. Figure 5 shows the existing municipal and irrigation water demands by hydrologic unit. Table 4 shows the existing amount of water used in a hydrologic unit, and Table 5 shows the amount of water withdrawn from a hydrologic unit. It should be noted that the water use figures do not directly impact upon the sustainable yields of the given hydrologic units. Water withdrawn describes the water taken from a hydrologic unit for use in the same or other hydrologic unit. Water use describes the water used in the hydrologic unit but the water can be transported from another hydrologic unit. So the withdrawal figures are directly related to the sustainable yield figures of a hydrologic unit. Water use and withdrawals are shown on Figures 5, 7 and 9 to graphically depict the areal distribution of water use.

A major independent water system has been established in Princeville community. The Princeville System serves domestic and commercial water needs for the Princeville community including residences, resort areas and small shopping areas and is included in the municipal water demand calculations. The estimated domestic and commercial water use for Princeville is approximately 0.7 mgd.

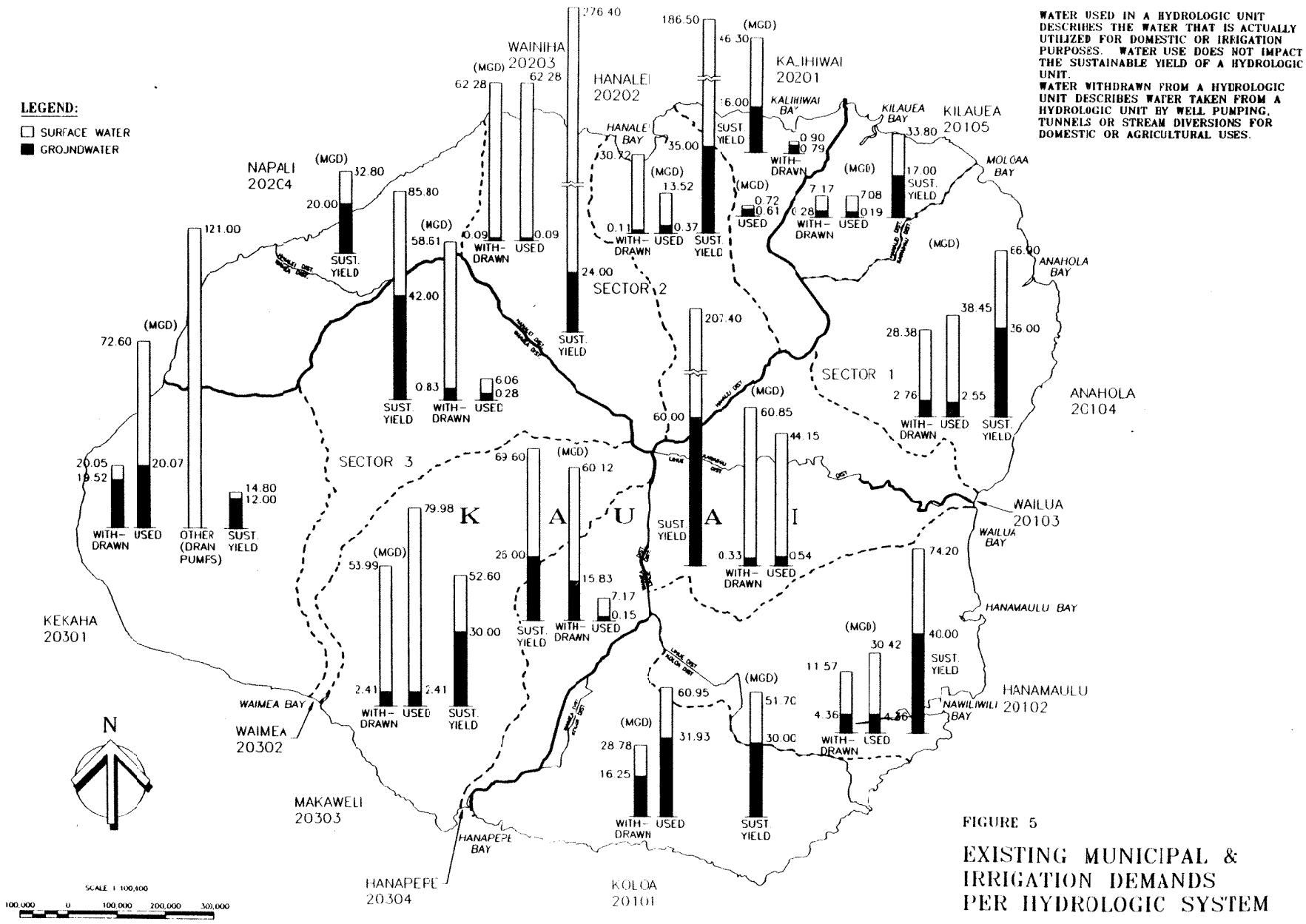

FIGURE 5

EXISTING MUNICIPAL & IRRIGATION DEMANDS PER HYDROLOGIC SYSTEM

TABLE 4

Kauai Water Use and Development Plan
EXISTING WATER USE SUMMARY
Water Used in Hydrologic Unit

Hydrologic System		Water Used (MGD)		Sus. Yield (MGD)	
		Ground	Surface	Ground	Surface
Koloa	20101	31.93	29.02	30	21.7
Hanamaulu	20102	4.36	26.08	40	34.2
Wailua	20103	0.54	43.61	60	147.0
Anahola	20104	2.55	35.91	36	30.9
Kilauea	20105	0.19	6.89	17	16.8
Kalihiwai	20201	0.61	0.11	16	30.3
Hanalei	20202	0.37	13.15	35	151.5
Wainiha	20203	0.09	62.18	24	252.4
Napali	20204	0.00	0.00	20	12.8
Kekaha	20301	20.07	52.53	12	2.8
Waimea	20302	0.28	5.78	42	43.8
Makaweli	20303	2.41	77.58	30	22.6
Hanapepe	20304	0.15	7.02	26	43.6

Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water used in a hydrologic unit describes where water is actually utilized for domestic or irrigation purposes. Water use does not directly impact the sustainable yield of a hydrologic unit as water could be withdrawn and transported from another hydrologic unit.

TABLE 5

Kauai Water Use and Development Plan
EXISTING WATER USE SUMMARY
Water Withdrawn from Hydrologic Unit

Hydrologic System		Water Withdrawn (MGD)		Sus. Yield (MGD)	
		Ground	Surface	Ground	Surface
Koloa	20101	16.25	12.53	30	21.7
Hanamaulu	20102	4.36	7.22	40	34.2
Wailua	20103	0.33	60.52	60	147.4
Anahola	20104	2.76	25.63	36	30.9
Kilauea	20105	0.28	6.89	17	16.8
Kalihiwai	20201	0.79	0.11	16	30.3
Hanalei	20202	0.11	30.61	35	151.5
Wainiha	20203	0.09	62.18	24	252.4
Napali	20204	0.00	0.00	20	12.8
Kekaha	20301	19.52	0.53	12	2.8
Waimea	20302	0.83	57.78	42	43.8
Makaweli	20303	2.41	51.58	30	22.6
Hanapepe	20304	15.83	44.28	26	43.6

Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water withdrawn from a hydrologic unit describes the water taken from a hydrologic unit by well pumping, tunnels, or stream diversions for domestic or agricultural uses.

FUTURE WATER NEEDS

Municipal water demand consists of water supply provided for Kauai customers of the Department of Water. These include the vast majority of residential, commercial, governmental and industrial users, as well as smaller agricultural farmers. A portion of the military water demand is also serviced by the Department of Water. The Princeville water system is included in the water demand estimates.

Future municipal water demand on Kauai is projected by major system areas and hydrologic units up to the year 2010. The projections are based on the widely accepted population projections developed by the State Department of Business and Economic Development, the most recent Series M-K projections.

The existing per capita consumption by district was used in projecting water demand for the planning period. The per capita consumption in gallons per capita per day (gpcd) rates used are; 187 gpcd for Waimea, 155 gpcd for Koloa, 202 gpcd for Lihue, 124 gpcd for Kapaa and 155 gpcd for Hanalei. A no increase or decrease in per capita consumption has been assumed through the planning period. The Princeville development, the Princeville water demand is included in the projections for the Hanalei area.

Table 6 shows the actual and projected municipal water demand from 1990 to 2010 based on the above methodology. Municipal and private potable water demand for Kauai is anticipated to increase from the current level of 10.51 million gallons per day (mgd) to 20.08 mgd by the year 2010.

The future water demand for agricultural pursuits is dependent on the type of crops cultivated and the number of acres under cultivation. Principal among these on Kauai are sugar and diversified agriculture. These demands are assumed not to change except for the State agricultural park developments.

Table 6 shows future water needs by planning areas, the 20-year or 2010 projections and the long range demand based on the County General Plan. Tables 7 and 8 present the projected 20-year water use within a hydrologic unit and withdrawn from a hydrologic unit, respectively. Figure 6 shows the projected 20-year demand by municipal system and Figure 8 shows the projected long range demand by municipal system based on zoning. Figure 7 shows the projected 20-year water demand by hydrologic unit and Figure 9 shows the long range demand hydrologic systems. Tables 9 and 10 presents the projected long range water use within a hydrologic unit and withdrawn from a hydrologic unit, respectively. The long range water use is determined by calculating the total water demand at full development of all the General Plan lands on Kauai. This is expected to occur after the year 2030 at present growth rates.

The water used in a hydrologic unit describes water actually utilized for domestic, commercial, industrial or agricultural purposes. Water use does not directly impact upon the sustainable yield of a hydrologic unit as the water used in a given hydrologic

TABLE 6

Kauai Water Use and Development Plan
WATER DEMAND SUMMARY (per Municipal System)

Municipal System	Well Cap. (MGD)	Water Demand (MGD) 1988	2010	Ultimate
Kekaha-Waimea	3.07	1.18	1.19	2.89
Hanapepe-Eleele	2.25	0.52	1.02	2.48
Koloa-Poipu	5.99	1.73	3.56	6.94
Kalaheo-Lawai	3.99	0.77	1.46	2.85
Lihue	6.94	2.45	5.92	8.59
Wailua-Kapaa	8.35	2.49	3.65	5.62
Anahola	0.72	0.13	0.18	0.28
Kilauea	2.02	0.28	0.45	0.82
Hanalei-Princeville	0.36	0.88	2.41	4.36
Wainiha-Haena	0.52	0.09	0.24	0.43
TOTALS:	34.21	10.52	20.08	35.26

Note: The above figures include Princeville.

TABLE 7

Kauai Water Use and Development Plan
PROJECTED 20-YEAR WATER USE SUMMARY
Water Used in Hydrologic Unit

Hydrologic System		Water Used (MGD)		Sus. Yield (MGD)	
		Ground	Surface	Ground	Surface
Koloa	20101	30.96	29.02	30	21.7
Hanamaulu	20102	7.55	26.08	40	34.2
Wailua	20103	1.89	43.61	60	147.4
Anahola	20104	7.56	35.91	36	30.9
Kilauea	20105	0.40	6.89	17	16.8
Kalihiwai	20201	1.27	0.11	16	30.3
Hanalei	20202	1.19	13.15	35	151.5
Wainiha	20203	0.25	62.18	24	252.4
Napali	20204	0.00	0.00	20	12.8
Kekaha	20301	20.21	52.53	12	2.8
Waimea	20302	0.23	5.78	42	43.8
Makaweli	20303	2.48	77.58	30	22.6
Hanapepe	20304	0.12	7.02	26	43.6

Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water used in a hydrologic unit describes where water is actually utilized for domestic or irrigation purposes. Water use does not directly impact the sustainable yield of a hydrologic unit as water could be withdrawn and transported from another hydrologic unit.

TABLE 8

Kauai Water Use and Development Plan
PROJECTED 20-YEAR WATER USE SUMMARY
Water Withdrawn from Hydrologic Unit

Hydrologic System		Water Withdrawn (MGD)		Sus. Yield (MGD)	
		Ground	Surface	Ground	Surface
Koloa	20101	15.28	12.53	30	21.7
Hanamaulu	20102	7.55	7.22	40	34.2
Wailua	20103	1.89	60.52	60	147.4
Anahola	20104	7.56	25.63	36	30.9
Kilauea	20105	0.49	6.89	17	16.8
Kalihiwai	20201	1.46	0.11	16	30.3
Hanalei	20202	0.93	30.61	35	151.5
Wainiha	20203	0.25	62.18	24	252.4
Napali	20204	0.00	0.00	20	12.8
Kekaha	20301	19.66	0.53	12	2.8
Waimea	20302	0.78	57.78	42	43.8
Makaweli	20303	2.48	51.58	30	22.6
Hanapepe	20304	15.80	44.28	26	43.6

Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water withdrawn from a hydrologic unit describes the water taken from a hydrologic unit by well pumping, tunnels, or stream diversions for domestic or agricultural uses.

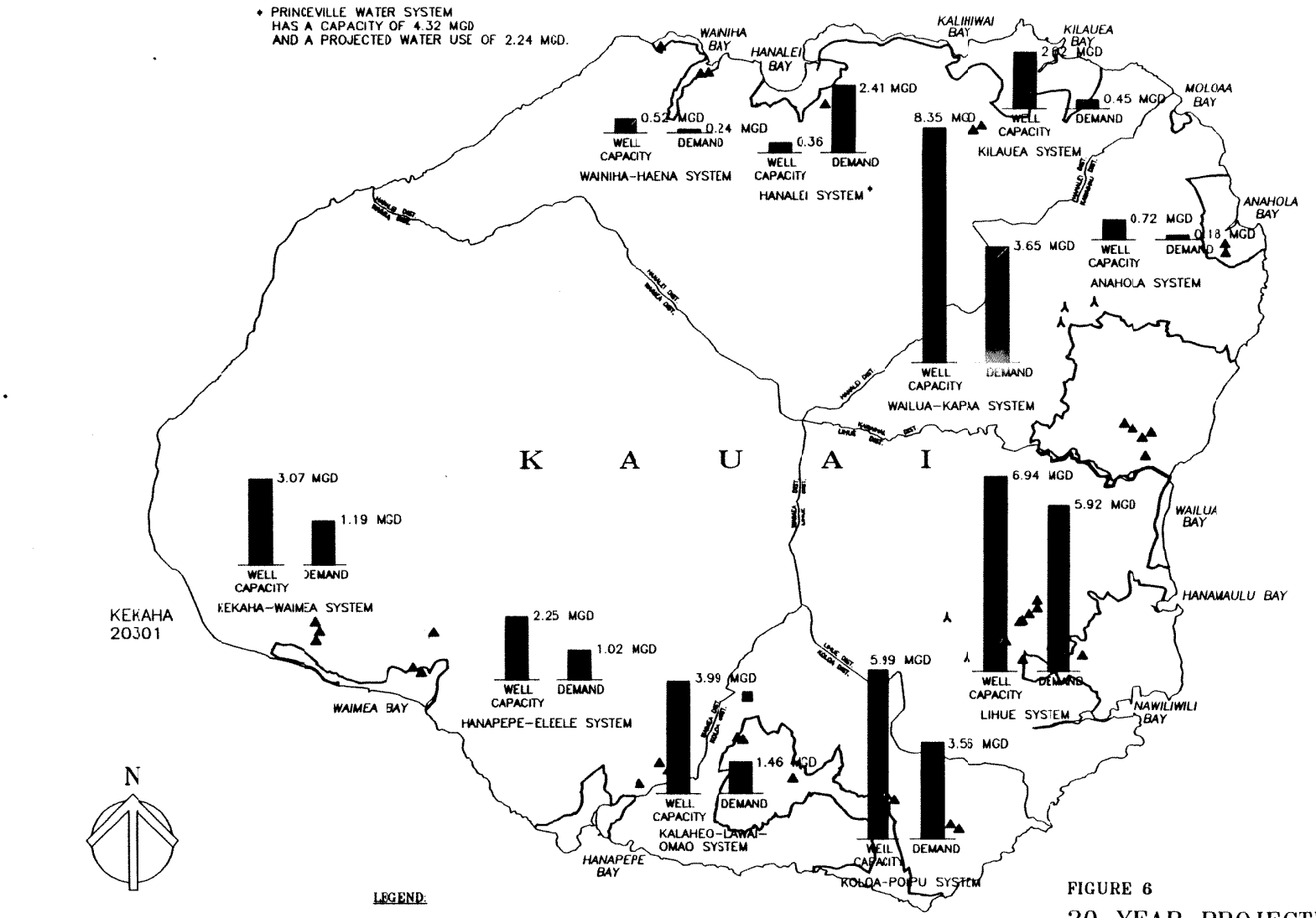

FIGURE 6

20 YEAR PROJECTED WATER DEMAND & WELL CAPACITIES PER MUNICIPAL SYSTEM

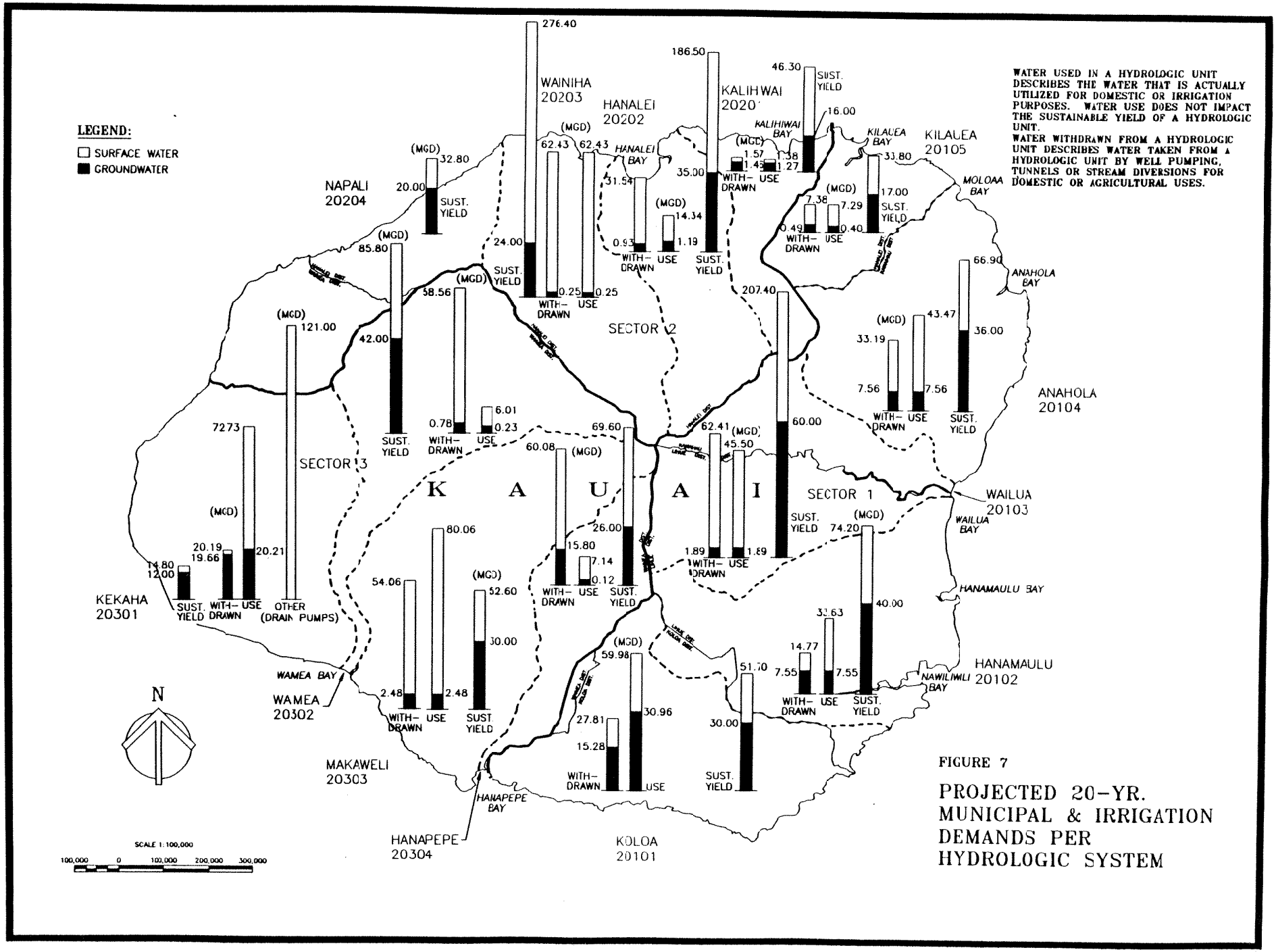

FIGURE 7

PROJECTED 20-YR. MUNICIPAL & IRRIGATION DEMANDS PER HYDROLOGIC SYSTEM

TABLE 9

Kauai Water Use and Development Plan
LONG RANGE WATER USE SUMMARY
Water Used in Hydrologic Unit

Hydrologic System		Water Used (MGD)		Sus. Yield (MGD)	
		Ground	Surface	Ground	Surface
Koloa	20101	36.31	29.02	30	21.7
Hanamaulu	20102	10.27	26.08	40	34.2
Wailua	20103	2.32	43.61	60	147.4
Anahola	20104	9.13	35.91	36	30.9
Kilauea	20105	0.71	6.89	17	16.8
Kalihiwai	20201	2.30	0.11	16	30.3
Hanalei	20202	2.14	13.15	35	151.5
Wainiha	20203	0.45	62.18	24	252.4
Napali	20204	0.00	0.00	20	12.8
Kekaha	20301	21.71	52.53	12	2.8
Waimea	20302	0.56	5.78	42	43.8
Makaweli	20303	2.95	77.58	30	22.6
Hanapepe	20304	0.28	7.02	26	43.6

Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water used in a hydrologic unit describes where water is actually utilized for domestic or irrigation purposes. Water use does not directly impact the sustainable yield of a hydrologic unit as water could be withdrawn and transported from another hydrologic unit.

TABLE 10

Kauai Water Use and Development Plan
LONG RANGE WATER USE SUMMARY
Water Withdrawn from Hydrologic Unit

Hydrologic System		Water Withdrawn (MGD)		Sus. Yield (MGD)	
		Ground	Surface	Ground	Surface
Koloa	20101	20.63	12.53	30	21.7
Hanamaulu	20102	10.27	7.22	40	34.2
Wailua	20103	2.32	60.52	60	147.4
Anahola	20104	9.13	25.63	36	30.9
Kilauea	20105	0.80	6.89	17	16.8
Kalihiwai	20201	2.48	0.11	16	30.3
Hanalei	20202	1.88	30.61	35	151.5
Wainiha	20203	0.45	62.18	24	252.4
Napali	20204	0.00	0.00	20	12.8
Kekaha	20301	21.16	0.53	12	2.8
Waimea	20302	1.11	57.78	42	43.8
Makaweli	20303	2.95	51.58	30	22.6
Hanapepe	20304	15.96	44.28	26	43.6

Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water withdrawn from a hydrologic unit describes the water taken from a hydrologic unit by well pumping, tunnels, or stream diversions for domestic or agricultural uses.

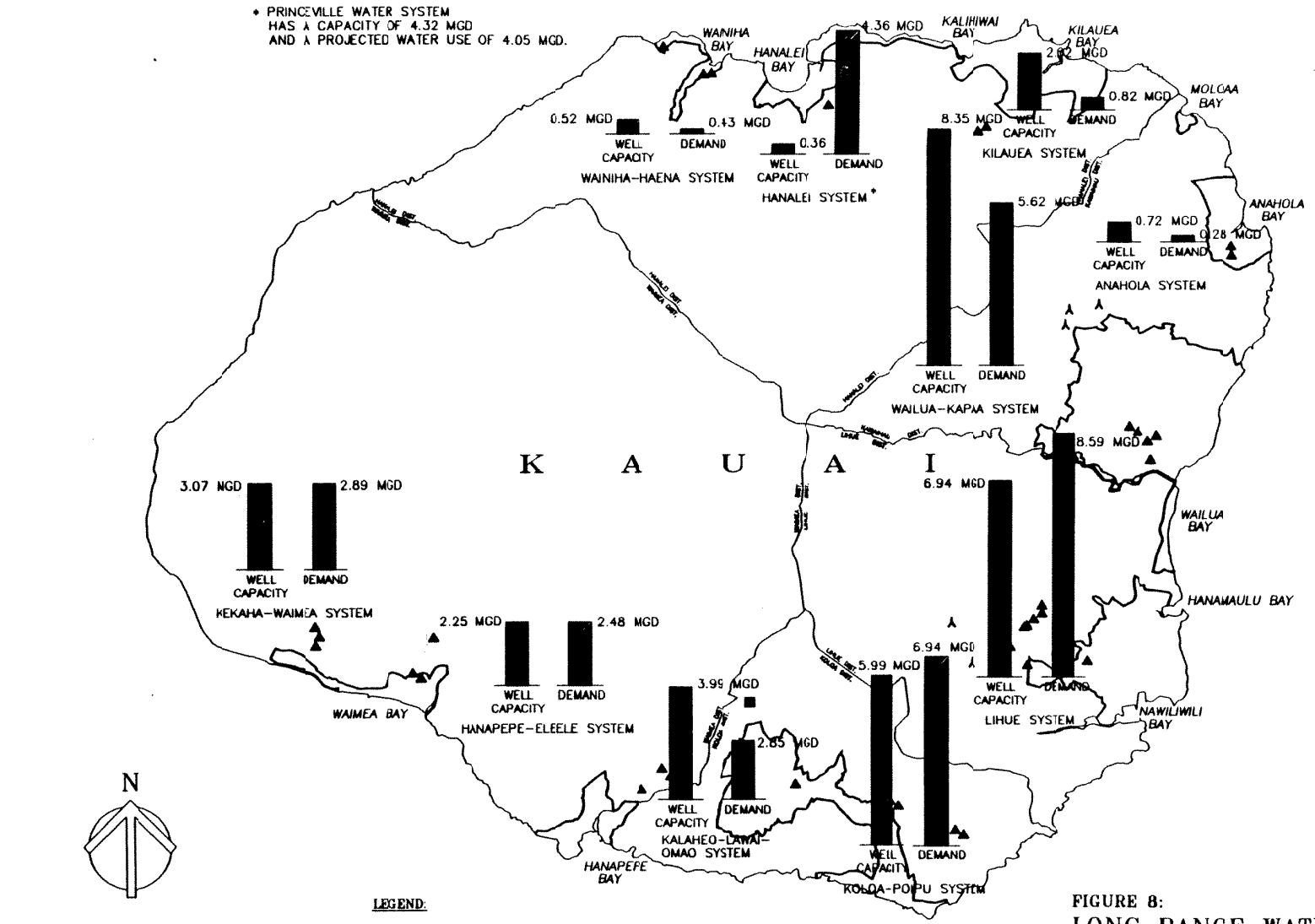

FIGURE 8:
LONG RANGE WATER DEMAND & WELL CAPACITIES PER MUNICIPAL SYSTEM

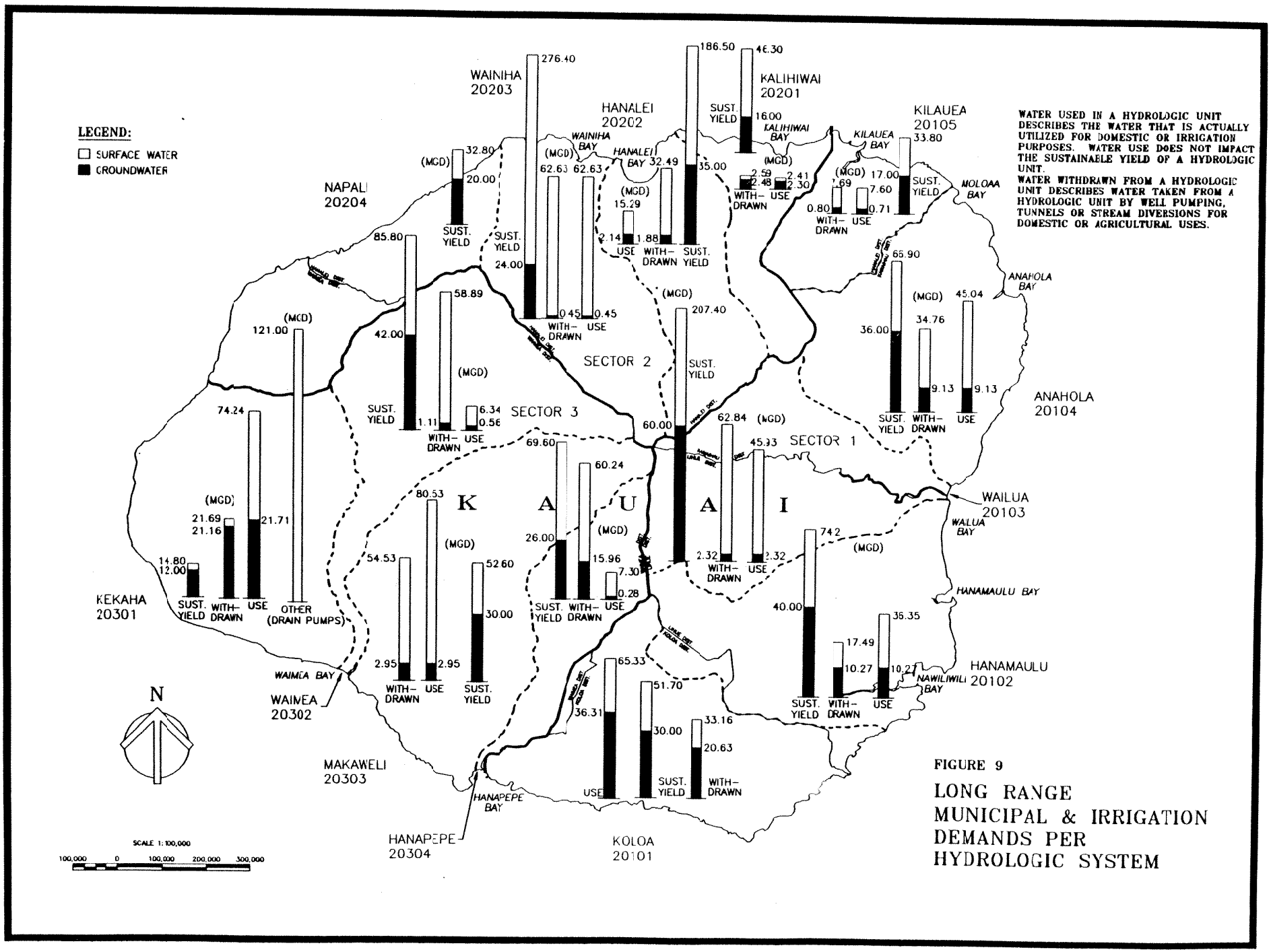

FIGURE 9

LONG RANGE MUNICIPAL & IRRIGATION DEMANDS PER HYDROLOGIC SYSTEM

unit can be withdrawn from another hydrologic unit. Water withdrawn from a hydrologic unit describes water taken from a hydrologic unit by well pumping, tunnels or stream diversions for domestic or agricultural purposes. This water may be used in another hydrologic unit.

The areas requiring the greatest amounts of water by the year 2010 are Kawaihau, Lihue and Koloa-Poipu. Kawaihau will need 1.16 mgd additional water supply to meet the projected population increase. Lihue, Koloa-Poipu and Kalaheo-Lawai will have additional needs of 3.47 mgd, 1.83 mgd, and 0.69, respectively. All other areas will need additionally about 0.5 mgd or less by the year 2010. The Hanalei-Kalihiwai area which includes Princeville will require another 1.53 mgd.

The sustainable yield figures show that groundwater water is available in the hydrologic units to meet the projected water demand beyond the year 2010, except for Kekaha. While the hydrologic units have the available sustainable yield to meet the projected demands, the DOW must develop the wells to extract the water from the ground for use. Potential sources have been identified by the present Water Master Plan and additional sources have been identified since then. Additional well testing and exploration will be required to meet the projected 2010 and long range demands. Alternative sources, including the expansion of surface water treatment facilities, will also have to be studied for the long range planning.

The Kekaha hydrologic unit is already importing potable water from the Waimea hydrologic unit to the Kekaha unit. The Lihue area or Hanamaulu Hydrologic unit can now import water from the Wailua-Kapaa or the Wailua hydrologic unit and portions of the Anahola hydrologic unit. This will be required to meet projected peak flow demands but there is adequate capacity to meet the average daily demands within the hydrologic unit. The Koloa-Poipu water system should be connected to the Lawai-Kalaheo system to increase the reliability of both systems.

The areal imbalances created by the importation of surface water for irrigation from one hydrologic unit to another is expected to persist as it exists today. Plans to convert some cane fields to residential or other urban activities will reduce irrigation requirements, reducing some of the areal imbalances. The conversion will also reduce groundwater requirements for irrigation as in the Koloa-Poipu and Kalaheo-Lawai areas.

PLAN IMPLEMENTATION

This section describes proposed water developments to be undertaken by government agencies and the private sector. In the County of Kauai, the coordination of public facilities with land use has been implemented through the General Plan process.

Table 11 lists by hydrologic unit the DOW source development and storage projects that will be required to meet the water demand for the next 20 years. Figure 10 shows the location of these proposed improvements. Proposed projects over the next 20-year timeframe will involve the expenditure of $94,000,000 in capital improvements for source production, storage, transmission and support facilities. Cost estimates are developed from the Oahu Board of Water Supply 6 - Year Capital Improvement Program cost estimates for well development and reservoir construction. Actual costs may vary from these estimates as more details on the proposed water source and storage developments are prepared.

The sugar plantations have adequate water supply for their irrigation requirements and have no plans or need for additional water development projects. Two State agricultural parks are expected to increase the groundwater demands by 4.8 mgd.

The primary development in the private sector will be the upgrade to the Princeville Water System. A new well and reservoir are planned to support their Phase 2 developments.

No new water sources are expected to be developed by any of the military installations.

State water development projects identified by the State Project Plan are listed in the appendix of the main report. The projects include Agricultural park irrigation systems and housing projects. The total water demand for these projects is estimated to be 8.9 mgd, of which 4.8 mgd in describe above. The remainder of the projected water demand for State Projects will be met by the municipal system.

The use of non-potable water for agricultural and industrial purposes could one day enhance the potable water supplies for municipal use. Results of the recent test project at the Honouliuli Waste Water Treatment Plant (WWTP) in Ewa (Oahu) support the potential benefits of waste water effluent reuse. The high salinity water can also be transformed by desalting plants to create potable supplies. The Department of Water can implement extensive water conservation programs similar to the programs on Oahu.

TABLE 11

Kauai Water Use and Development Plan
PROPOSED WATER DEVELOPMENTS FOR KAUAI
DOW DEVELOPMENTS

	System		Type of Improvement	Capacity	Cost
Kekaha-Waimea	301	1	Wells	600 gpm	$2,242,080
		2	Reservoir	1 mg	$3,376,000
	302	3	Exploratory Wells	n.a.	$360,000
Hanapepe-Eleele	304	1	Well	700 gpm	$2,615,760
		2	Reservoir	1 mg	$3,376,000
		13000	Lineal Feet of Pipe	12 in	$975,000
Kalaheo-Lawai	101	1	Well	700 gpm	$2,615,760
		3	Reservoir	1 mg	$5,064,000
Koloa-Poipu	101	2	Well	800 gpm	$5,978,880
		1	Well	1200 gpm	$4,484,160
		7	Reservoir	1 mg	$11,816,000
		12600	Lineal Feet of Pipe	12 in	$945,000
Lihue	102	3	Wells	200 gpm	$2,242,080
		2	Well	700 gpm	$5,231,520
		5	Reservoir	1 mg	$8,440,000
		18500	Lineal Feet of Pipe	12 in	$1,387,500
Wailua-Kapaa	104	1	Well	1000 gpm	$3,736,800
		3	Well	700 gpm	$7,847,280
		2	Well	600 gpm	$4,484,160
		7	Reservoir	1 mg	$11,816,000
		12000	Lineal Feet of Pipe	12 in	$900,000
Kilauea	105	1	Well	700 gpm	$2,615,760
		1	Reservoir	0.5 mg	$844,000
Hanalei	202	1	Well	250 gpm	$934,200
Princeville	201	1	Well	1500 gpm	n.a.
		1	Reservoir	1.5 mg	n.a.
TOTAL					$94,327,940

Unit prices developed from Oahu BWS C.I.P.

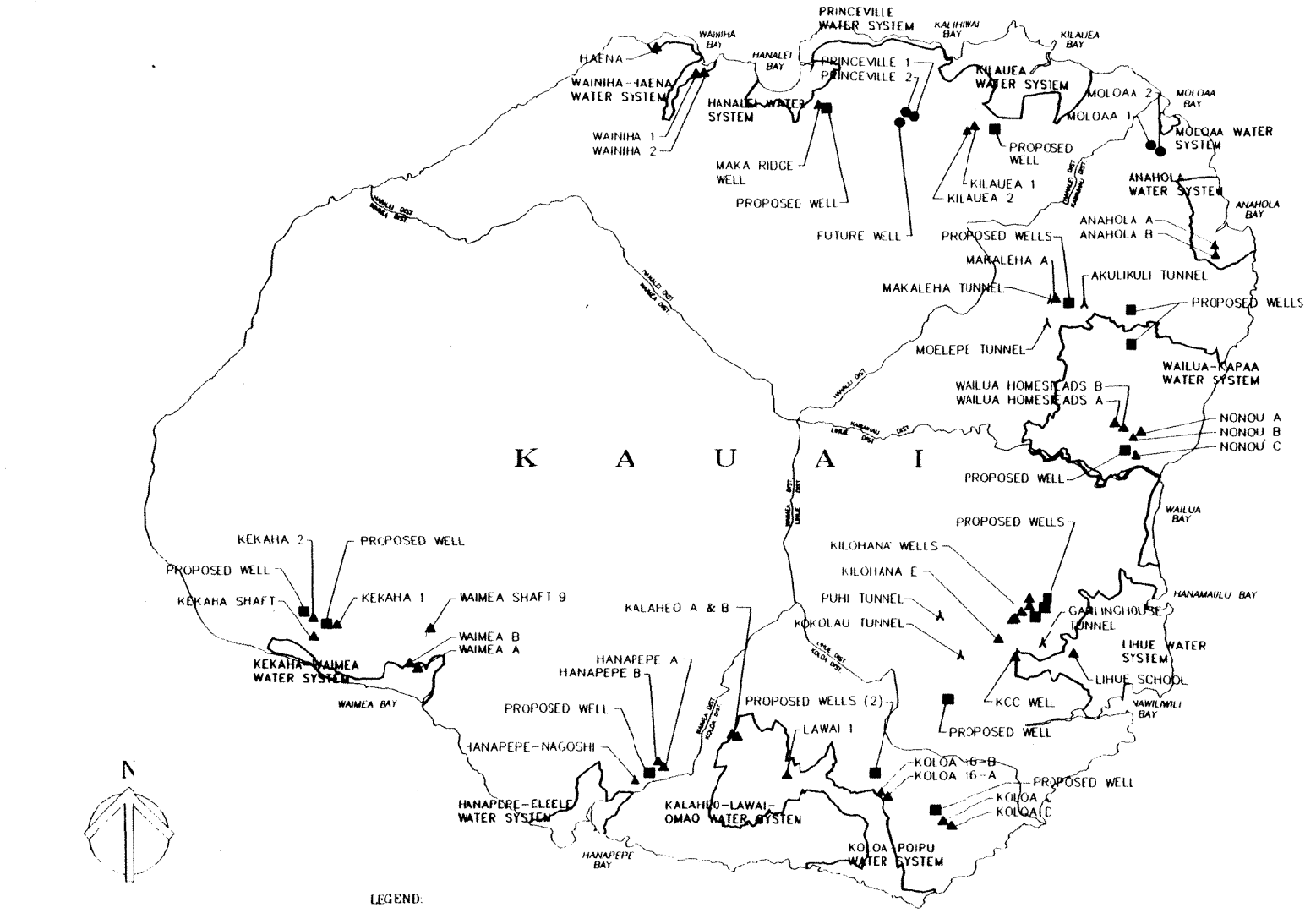

FIGURE 10:
MUNICIPAL SYSTEMS & GROUNDWATER SOURCES

ORDINANCE NO. 568 BILL NO. 1321, Draft 1

A BILL FOR AN ORDINANCE AMENDING
TITLE IV OF THE KAUAI COUNTY CODE 1987
TO ADOPT A WATER USE AND
DEVELOPMENT PLAN FOR THE COUNTY OF KAUAI

BE IT ORDAINED BY THE COUNCIL OF THE COUNTY OF KAUAI, STATE OF HAWAII:

SECTION 1. Title IV of the Kauai County Code 1987 is hereby amended by adding a new chapter to be designated and to read as follows:

"CHAPTER 11B

WATER USE AND DEVELOPMENT PLAN

ARTICLE 1. GENERAL PROVISIONS

Sec. 11B-1.1 Purpose.

The state water code (HRS Chapter 174C) mandates the preparation and adoption of a water use and development plan by each county as part of the Hawaii water plan.

Sec. 11B-1.2 Definitions.

As used in this chapter, unless the context otherwise requires:

"Board" means the board of water supply for the county of Kauai.

"Commission" means the commission on water resource management.

"Community plans or community development plans" means those plans adopted by ordinance under Chapter 10, Kauai County Code 1987.

"Department of Water" means the Department of Water for the County of Kauai.

"Domestic use" means any use of water for individual personal needs and for household purposes such as drinking, bathing, heating, cooking, noncommercial gardening, and sanitation.

"General plan" means the General Plan adopted by Chapter 7, Kauai County Code 1987, setting forth "policies to govern the future physical development of the County."

"Ground water" means any water found beneath the surface of the earth, whether or not in perched, dike-confined, or basal supply; in underground channels or streams; in standing, percolating, or flowing condition; or under artesian pressure.

"Hawaii water plan" means the integrated program of the commission for the protection, conservation, and management of the waters of the state, with such amendments, supplements, and additions as may be necessary, mandated by the state water code (HRS Chapter 174C).

"Hydrologic unit" means a surface drainage area or a ground water basin or a combination of the two as described in the Hawaii water plan, which shall be determined using the best available information.

"Municipal use" means the domestic, industrial, and commercial use of water through public services available to persons of a county for the promotion and protection of their health, comfort, and safety, for the protection of property from fire, and for the purposes listed under the term "domestic use."

"Person" means any individual, firm, association, organization, partnership, estate, trust, corporation, company, or any governmental unit.

"Reasonable-beneficial use" means the use of water in such quantity as is necessary for economic and efficient utilization, for a purpose, and in a manner which is not wasteful and is both reasonable and consistent with the state and county land use plans and the public interest.

"Surface water" means both contained surface water (that is, water upon the surface of the earth in bounds created naturally or artificially including, but not limited to, streams, other watercourses, lakes, and reservoirs) and diffused surface water (that is, water occurring upon the surface of the ground other than in contained waterbodies). Water from natural springs is surface water when it exits from the spring onto the earth's surface.

"Sustainable yield" means the maximum rate at which water may be withdrawn from a water source without impairing the utility or quality of the water source as determined by the commission.

"Water" or "waters of the state" means any and all water on or beneath the surface of the ground, including natural or artificial watercourses, lakes, ponds, or diffused surface water and water percolating, standing, or flowing beneath the surface of the ground.

"Water source" means a place within or from which water is or may be developed, including but not limited to: (1) generally, an area such as a watershed defined by topographic boundaries, or a definitive ground water body; and (2) specifically, a particular stream, other surface water body, spring, tunnel, or well related combination thereof.

Sec. 11B-1.3 **Consistency Requirements.**

The water use and development plan shall be consistent with (1) the water resource protection and water quality plans of the Hawaii water plan; (2) county land use plans and policies including general plans, community plans and zoning; and (3) state land use classification and policies.

ARTICLE 2. WATER USE AND DEVELOPMENT PLAN

Sec. 11B.2.1 **Contents Of Water Use And Development Plan.**

The county water use and development plan shall include, but not be limited to: (1) Status of county water and related land development including an inventory of existing water uses for domestic, municipal, and industrial users, agriculture, aquaculture, hydropower development, drainage, reuse, reclamation, recharge, and resulting problems and constraints; (2) Future land uses and related water needs; and (3) regional plans for water

developments including recommended and alternative plans, costs, adequacy of plans, and relationship to the water resource protection plan and water quality plan.

Sec. 11B-2.2 **Water Use And Development Plan Preparation.**
The department of water shall be responsible for the preparation and maintenance of the Kauai county water use and development plan.

Sec. 11B-2.3 **Adoption Of The Water Use And Development Plan.**
The "Kauai Water Use and Development Plan" and "Executive Summary" dated February 1990, is incorporated herein by reference, and is hereby adopted."

Sec. 11B-2.4 **Application Of The Water Use And Development Plan.**
The water use and development plan shall serve as a guideline by agencies or departments of the county (a) in approving or recommending to other agencies the use or commitment of the county's municipal, public water resources, and (b) in using public funds to develop water resources to meet existing or projected future demands on the public water system as set forth in the water use and development plan.

Sec. 11B-2.5 **Amendment.**
The Board of Water and the Department of Water shall have the authority to amend the water use and development plan to reflect changes in hydrologic or other scientific information and land use. Amendments for any other reason shall be by ordinance.

Sec. 11B-2.6 **Severability.**
The invalidity of any word, section, clause, paragraph, sentence, part or provision of this chapter shall not affect the validity of any other part of this chapter which cannot be given effect without such invalid part of parts."

SECTION 2. This ordinance shall take effect upon its approval.

INTRODUCED BY:

James Tehada

JAMES TEHADA
(By Request)

Date of Introduction:

April 11, 1990

Lihue, Kauai, Hawaii

CERTIFICATE OF THE COUNTY CLERK

I hereby certify that heretofore attached is a true and correct copy of Bill No. 1321, Draft 1, which was passed on second and final reading by the Council of the County of Kauai at its meeting held on April 11, 1989, by the following vote:

FOR ADOPTION: Asing, Fukushima, Kouchi, Santos, Munechika, Tehada, Correa — TOTAL - 7,

AGAINST ADOPTION: None — TOTAL - 0,

EXCUSED & NOT VOTING: None — TOTAL - 0.

April 11, 1990

Jerome Y.K. Hew
County Clerk, County of Kauai

ATTEST:

MAXINE CORREA
CHAIRPERSON & PRESIDING OFFICER

DATE OF TRANSMITTAL TO MAYOR:

April 12, 1990

Approved this 27th day of April, 1990.

JOANN A. YUKIMURA
Mayor
County of Kauai

SECTION 1

INTRODUCTION

1.1 PURPOSE

In 1978, the State of Hawaii Constitution was amended to mandate that "the State has an obligation to protect, control, and regulate the use of Hawaii's water resources for the benefit of its people." Nine years later, the State Water Code was enacted by the Legislature as Act 45, Session Laws of Hawaii 1987. The Commission on Water Resource Management through the State Water Code is empowered to set forth overall water conservation, quality and use policies; define beneficial and reasonable uses; protect ground and surface water resources, watersheds and natural stream environments; and establish criteria for water use policies and procedures for regulating all users of Hawaii's water resources.

One of the primary policies of the State Water Code is the need for a program of comprehensive water resources planning to address the problems of supply and conservation of water. The Hawaii Water Plan is intended to fulfill this comprehensive planning requirement through four component parts: a water resource protection plan, water use and development plans for each County, a water projects plan, and a water quality plan. As one of the component plans, the Kauai Water Use and Development Plan is intended to set forth the water use and development planning considerations for the County of Kauai.

1.2 SCOPE

As required by the State Water Code, the County Water Use and Development Plans are to include:

(1) Status of water and related land development including an inventory of existing water uses for domestic, municipal, and industrial uses, agriculture, aquaculture, hydropower development, drainage, reuse, reclamation, recharge, and resulting problems and constraints;

(2) Future land uses and related water needs; and

(3) Regional plans for water developments including recommended and alternative plans, costs, adequacy of plans, and relationship to water resource protection and quality plan.

The State Water Code (Chapter 174C, Hawaii Revised Statutes) further requires that the Water Use and Development Plan be adopted by ordinance and set forth the allocation of water to land use within the County of Kauai. The Plan is to be consistent with the State Water Resource Protection and Quality Plan, State land use classification and policies, and County land use plans and policies. Finally, the Plan is to be updated

and modified as necessary by the County of Kauai in order to maintain consistency with land use policies and zoning.

Project updates were prepared as part of the first phase of the Kauai Water Use and Development Plan. The updates described the background and setting for the water use planning considerations in the County of Kauai. The report described in detail the nature and extent of Kauai's water supply, and existing water uses and water developments on Kauai, including municipal, plantation agriculture, military, private domestic, individual household, small irrigation, native Hawaiian auwai and others.

The second phase in the preparation of the Kauai Water Use and Development Plan included an estimate of future water demands compared with the available supply of water on Kauai. The projected demand for water was examined based upon County and State land use policies. Programs which would provide for optimal use of the available supply have been explored, primarily the provision of additional potable water through source development. Desalinization, greater use of non-potable water sources, redistribution of the available supply, improved conservation efforts, and other alternatives for meeting the anticipated water demand were looked at in lesser detail.

The first and second phase efforts have been compiled into this document containing the basic research and analysis supporting the Kauai Water Use and Development Plan. The third and final phase consists of the preparation of a draft ordinance which shall be adopted by the County Council. The ordinance will be supported by a summary of the research and analysis of this document.

This document and proposed Water Use and Development Plan ordinance will be made available for public and agency review in conjunction with public meetings and hearings as may be required for final adoption by the Kauai County Council.

SECTION 2

PLANNING

2.1 SETTING

The County of Kauai has a land area of 353.900 acres, the fourth largest island in the Hawaiian chain. The Island of Kauai comprises less than 10 percent of the land area of the State of Hawaii. Kauai had an estimated resident population of 47,600 in 1987.

2.2 CLIMATE

The climate of Kauai, which is mild and equitable throughout the year, is due to the island's location on the northern fringe of the tropics within the belt of cooling northeasterly trade winds. Humidity of the area is generally within the 60 to 80 percent range. The average temperature in the lowlands is 75°F, decreasing 4°F with each 1,000 feet increase in elevation.

The coldest month, January, averages 72°F and the warmest, August, 78.5°F. Maximum temperatures rarely exceed 90°F, and minimum temperatures hover around 50°F.

Annual average rainfall on Kauai ranges from less than 20 inches on the leeward coast to over 400 inches near Mount Waialeale. The mountains intercept prevailing trade winds, the moisture carried by these winds is lifted, cooled, and thereby condensed into rain. Rainfall is heaviest on Mt. Waialeale and decreases in the lower elevations and to the leeward side of the island.

Trade winds prevail throughout the year, but are least continuous from October through April, Hawaii's winter season. During these months, tropical storms occasionally bring heavy rains.

2.3 GEOLOGY

The islands of the Hawaiian archipelago are emerged volcanoes on a great submarine ridge that extends northwesterly and southeasterly for 1,600 miles in the central Pacific Ocean. This ridge, rising from ocean depths of 20,000 feet, was formed from immense quantities of lava, flow upon flow, spewing forth from various points and fissures along a major fracture zone.

The sequential formation of the archipelago is indicated by the occurrence of submerged older islands in the northwest portion of the chain and by he youngest island at its southeast end, where volcanic activity continues. Eight of the islands are of sufficient elevation to intercept trade wind moisture and large enough to permit settlement.

The Island of Kauai consists essentially of a single dome. Lava flows dip outward in all directions from the principal volcanic center near Mount Waialeale. The dome is slightly elongated in a northeast-southwest direction, and a slight bulge was produced on the southeastern slope of the dome by another eruptive center of Haupu. The smooth profile of the dome was another marred by the depression of the summit caldera; the smaller Haupu caldera (the Makaweli depression) and a nearly circular basin, the Lihue depression, on the east side. Within the main caldera, eruptions built a smaller constructional dome, similar to the major dome but with much gentler slopes.

2.4 HYDROLOGY

Hawaii's water resources vary greatly between islands as well as within each island. There are perennial streams and flash streams, rain forests and cactus deserts. There are groundwater tunnels high in the mountains and low near sea level.

A continuous cycle of water can be easily traced on small oceanic islands like Hawaii. The pattern of the cycle will vary at different times and places according to variations in geology, landform, soils, and rainfall. The cycle is also modified by human activities, such as diverting mountain stream water for irrigation, pumping groundwater, changing infiltration by resurfacing the land, altering evapotranspiration and runoff patterns by agricultural and urban development, and disposing of sewage effluent into the ocean. The volcanic rock and their residual soils have a very great capacity to absorb and percolate water, and consequently, only a relatively small proportion of the rainfall runs over the surface to the sea. Much of it infiltrates into the ground, creating the large groundwater bodies on which Kauai depends for its potable water supply.

There are several types of general groundwater bodies on Kauai (see Figures 1 and 1a). The most extensive is the "basal freshwater lens" that floats on sea water under much of the island. Caprock sources are also found. Less widespread, but of singular importance in some areas, is groundwater restrained between impermeable vertical rock structures called "dikes." The third type of minor significance is groundwater held up, or "perched," on horizontal impermeable beds such as volcanic ash (see Figure 1).

Of lesser importance to Kauai's drinking water resources, but very significant to agricultural pursuits, is streamflow from perennial and intermittent streams. Precipitation and evapotranspiration are also important considerations in understanding the hydrologic cycle and its influence on Kauai's water supply.

2.4.1 Basal Water

The basal water bodies exist because of the difference in density between fresh water and sea water. Fresh water floats on the heavier sea water, both of which permeate the subsurface rock. This relationship is known as the Ghyben-Herzberg principle. The density ratio between fresh water and salt water is such that, theoretically, for each foot that the freshwater lens stands above sea level, the lens extends 40 feet below sea level to a midpoint where salinity is half sea water. A zone of mixture or transition zone

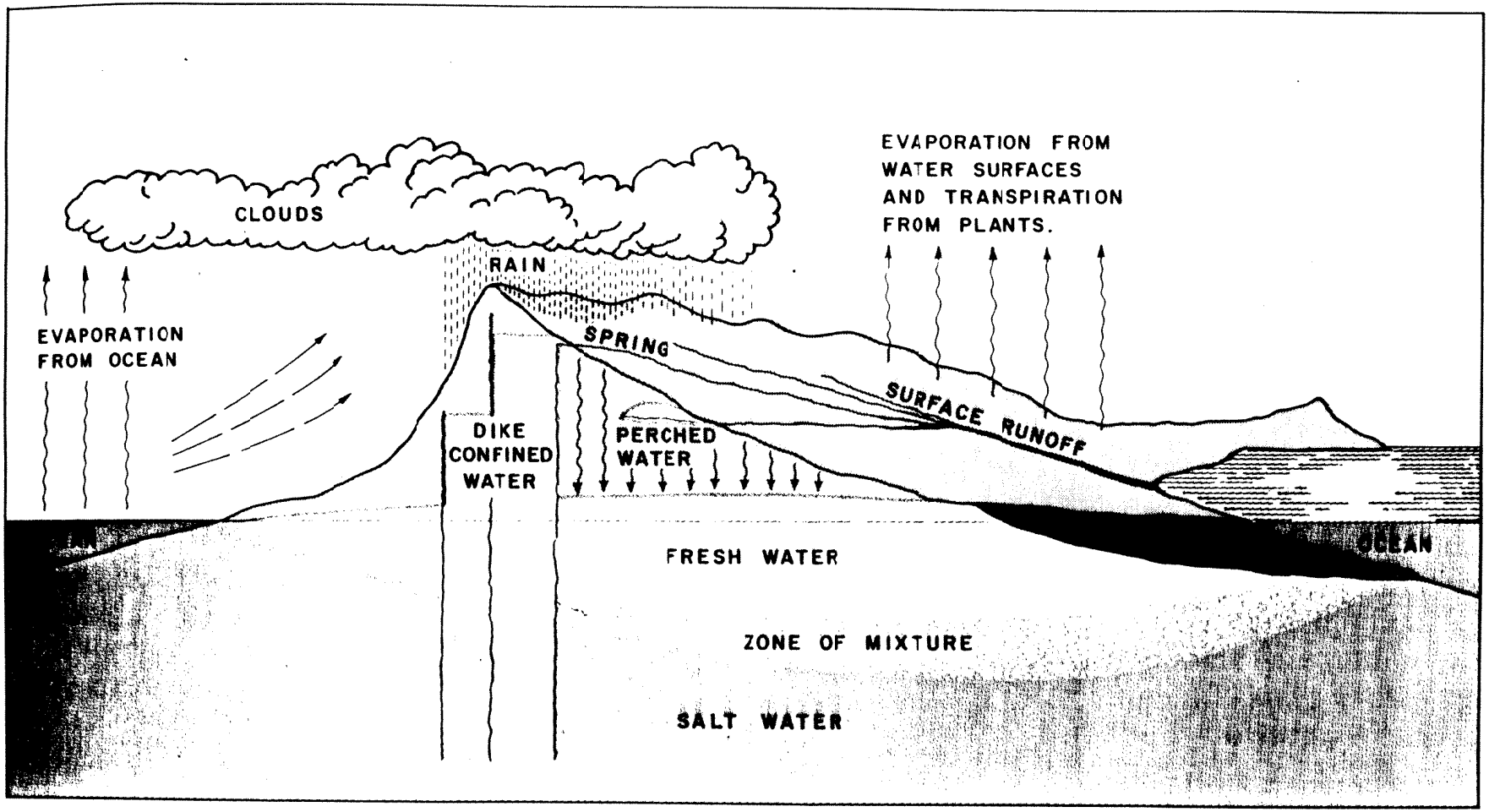

FIGURE 1:

HYDROLOGIC CYCLE

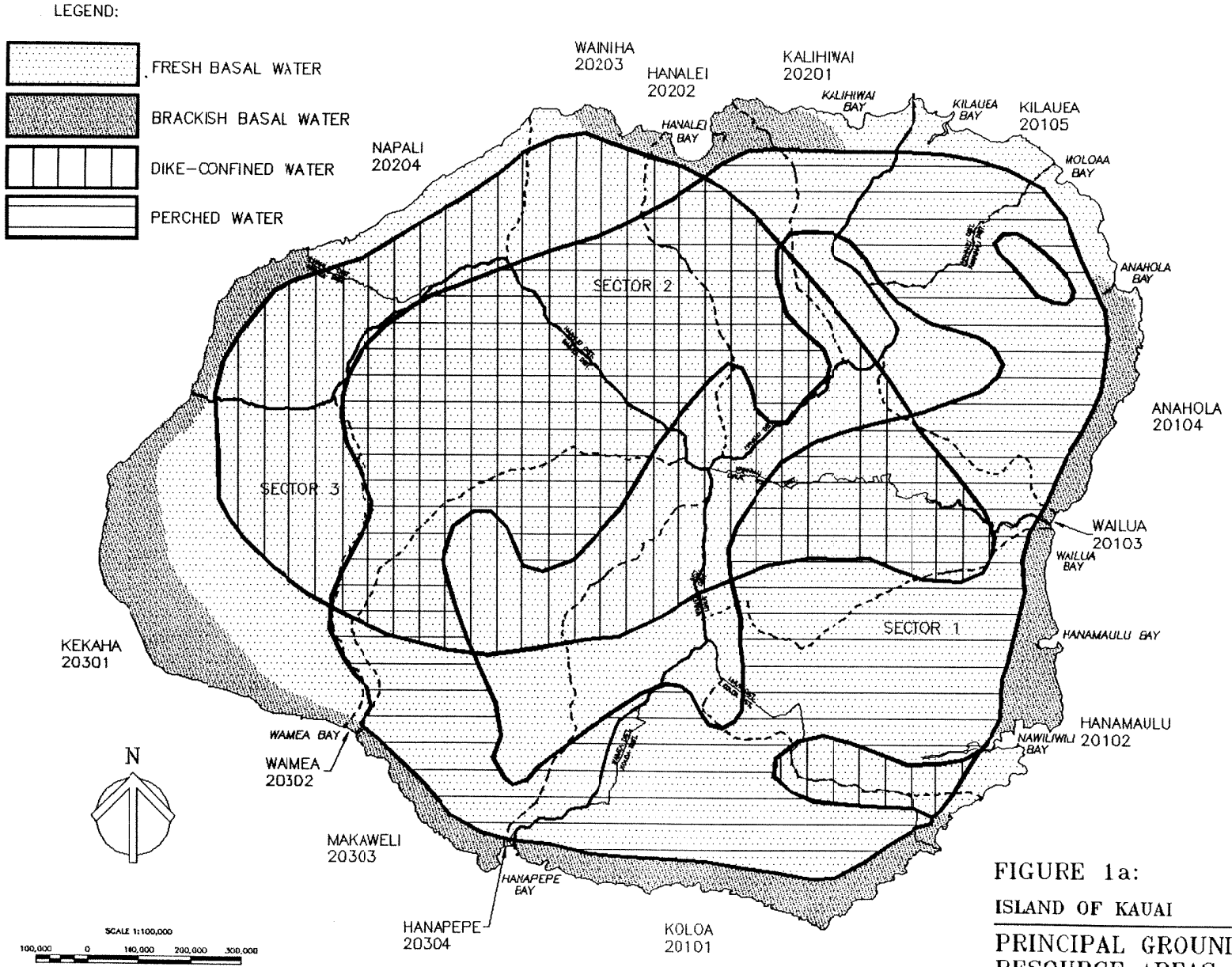

FIGURE 1a:

ISLAND OF KAUAI

PRINCIPAL GROUND WATER RESOURCE AREAS

exists where the water becomes fresher at the top of the zone and sea water at the bottom. For example, if the freshwater head was found to be 20 feet above sea level, it can be reasonably estimated that the depth to the midpoint of the transition zone would be approximately 800 feet below sea level.

The complexity of the geology of Kauai and the wide range in the permeability of the lava flows are not favorable for the formation of large, well developed Ghyben-Herzberg lenses, such as those in the Islands of Oahu and Maui. In much of Kauai, the rocks above and below sea level are thick bedded, massive, dense, and of generally low permeability. In these rocks such as the Koloa Basalts, the fresh water may not occur as buoyant systems that are characteristic of well developed Ghyben-Herzberg lenses in rock of higher permeability. In some areas of higher permeability, the aquifers are cut by dikes or other structures that limit the extent of the freshwater lenses. In other areas, where the extent of permeable rock is large, the recharge of fresh water apparently is too small to maintain well developed lenses of fresh water.

2.4.2 Caprock Water

In some coastal areas there is a relatively impermeable sediment sequence commonly called "caprock." This caprock barrier tends to restrict the seaward flow of freshwater and causes the thickness of the freshwater lens to be greater than it would if the caprock was absent. Depending upon the effectiveness of the caprock, the resulting lens could range from minor local thickening of a few feet to a relatively thick lens of several hundred feet. Caprock water is derived from local rainfall, return irrigation water and leakage of basal water bodies.

2.4.3 Dike Water

Water impounded in lava flows behind impermeable dikes is called "dike water," or "high-level water." Dikes are formed when molten magma intrudes and solidifies in conduits within the volcano's rift zone. These conduits may feed eruptions on the surface or may stay beneath the surface. Typically, they consist of nearly vertical slabs of dense, massive rock, a few feet thick, that cut across existing older lava flows. High level water impounded in permeable lavas occurring between dikes in the interior portions of Kauai is of excellent quality. Water leaking through the dikes or overflowing the top of the dikes flows into the basal lens. In many cases, dike-impounded water discharges at the ground surface where stream or wave erosion has breached dike compartments.

2.4.4 Perched Water

This type of water is "perched" on top of layers of impermeable material such as dense volcanic rock, beds of weathered and solidified ash, or clay-bearing sediments. Discharge of perched water sometimes occurs as springs where the perching member has been breached by erosion especially on the valley walls. Perched water occurs more

extensively in the lava flows under the lava slopes of the island, although the saturated zones are thin or the lavas have low permeability. Perched water supplies can be developed by tunnels or by constructing masonry chambers around spring orifices to collect flow and to prevent surface contamination. This type of water is of excellent quality.

2.4.5 Brackish Water

Water occurring in the caprock, the basal water transition zone, and basal springs comprise a large resource that is presently unused for municipal supplies due to excessive mineral content. Chlorides range from just above recommended drinking water limits to that of sea water.

Where fresh and salt water merges, a brackish zone of mixture forms. The movement of this transition zone, both horizontally inland from the seacoast and vertically upward, present a constant potential danger of saline contamination to there fresh water portion of the system. Skillful methods are absolutely necessary in developing the buoyant fresh water.

Utilization of brackish water sources for municipal supplies requires reduction of chlorides by blending and/or demineralization. Water containing more than 250 ppm of chloride ion is considered undesirable for drinking.

2.4.6 Streamflow

Perennial streams flow to the sea in all parts of Kauai, except in the area west of the Waimea Canyon. The major streams are large and have relatively uniform flow in comparison with those of other islands of Hawaii. All the large streams begin in the rainy uplands, especially Mt. Waialeale, and in at least their upper reaches, flow in deep, steep-walled valleys. The low flow of the streams is maintained by direct runoff from persistent rainfall in the mountains and by the discharge of water from high level springs and seeps. Water in the streams is extensively developed for sugarcane irrigation and is transported long distances through complex ditch and tunnel systems to the irrigate field.

2.4.7 Precipitation

The rainfall pattern on Kauai is characterized by a single maximum, Waialeale, near the island's highest point, Kawaikini, at 5,243-foot elevation, and a minimum, Kekaha, along the western coast of the island. The rain gage at Mt. Waialeale receives more rainfall than any other gage in the world. With an annual median of 449 inches, it is one of the wettest locations on earth. A mere 15.5 miles southwest of Waialeale, the Kekaha annual minimum is less than 19.7 inches.

The annual rainfall cycle differs from place to place in Hawaii, but certain features are

common to areas with similar exposures. The ancient Hawaiians recognized two seasons, the high sun period corresponding to warm temperatures and steady trade winds; and the cooler period when trade winds are less frequent and widespread storm rainfall is more common. Climatologists today are in general agreement with the Hawaiian system, although a 5-month summer and 7-month winter are generally used.

2.4.8 Evapotranspiration

Evapotranspiration is the loss of water from the surface and near surface zones, both by direct evaporation and by plant usage or transpiration. It represents the portion of the precipitation that is not available for infiltration or surface runoff. Evapotranspiration is primarily influenced by such factors as temperature, humidity, rainfall, and winds. In Hawaii, evapotranspiration varies widely both in time and space, although annual variations at any one place tend to be small. Maximum evapotranspiration occurs generally in the dry summer months. In areas of heavy rainfall, evapotranspiration losses may be only a small percentage of total precipitation; however, in areas with low rainfall, all or most of the rainfall may be lost to evapotranspiration.

2.5 HYDROLOGIC UNITS AND WATER AVAILABILITY

A program was initiated to classify and assign codes to the principal aquifers to each island in the State of Hawaii. The product is a single consistent scheme of classification and nomenclature that will serve as a framework for groundwater protection strategy. The effort was initiated several years ago by the Department of Health in response to U.S. Environmental Protection Agency directives and is being carried out by the Water Resources Research Center of the University of Hawaii for the Department of Health. George Yuen and Associates, Inc., is preparing the State Water Resources Protection Plan for the Department of Land and Natural Resources which utilizes this information.

The classification scheme starts with the Island as the largest component in the hierarchy, followed by Aquifer Sectors and Aquifer Systems. Aquifer Types and Aquifer Units will also be identified. Aquifer sectors reflect broad hydrogeological similarities yet maintain traditional hydrographic, topographic and historical boundaries where possible. Aquifer Systems are more specifically defined by hydrogeologic continuity, in particular hydraulic connections among Aquifer Types and Units. Aquifer Types are differentiated by distinctive features of hydrology and geology. Aquifer type coding is not yet available for Kauai. The Aquifer System is the logical category for computing water budgets and deriving sustainable yield.

The hierarchy is as follows:

1. Island: The largest component.
2. Sector: An area with broad hydrogeological similarities. The Island of Kauai is divided into three sectors as denoted by the heavy lines in Figure 2.

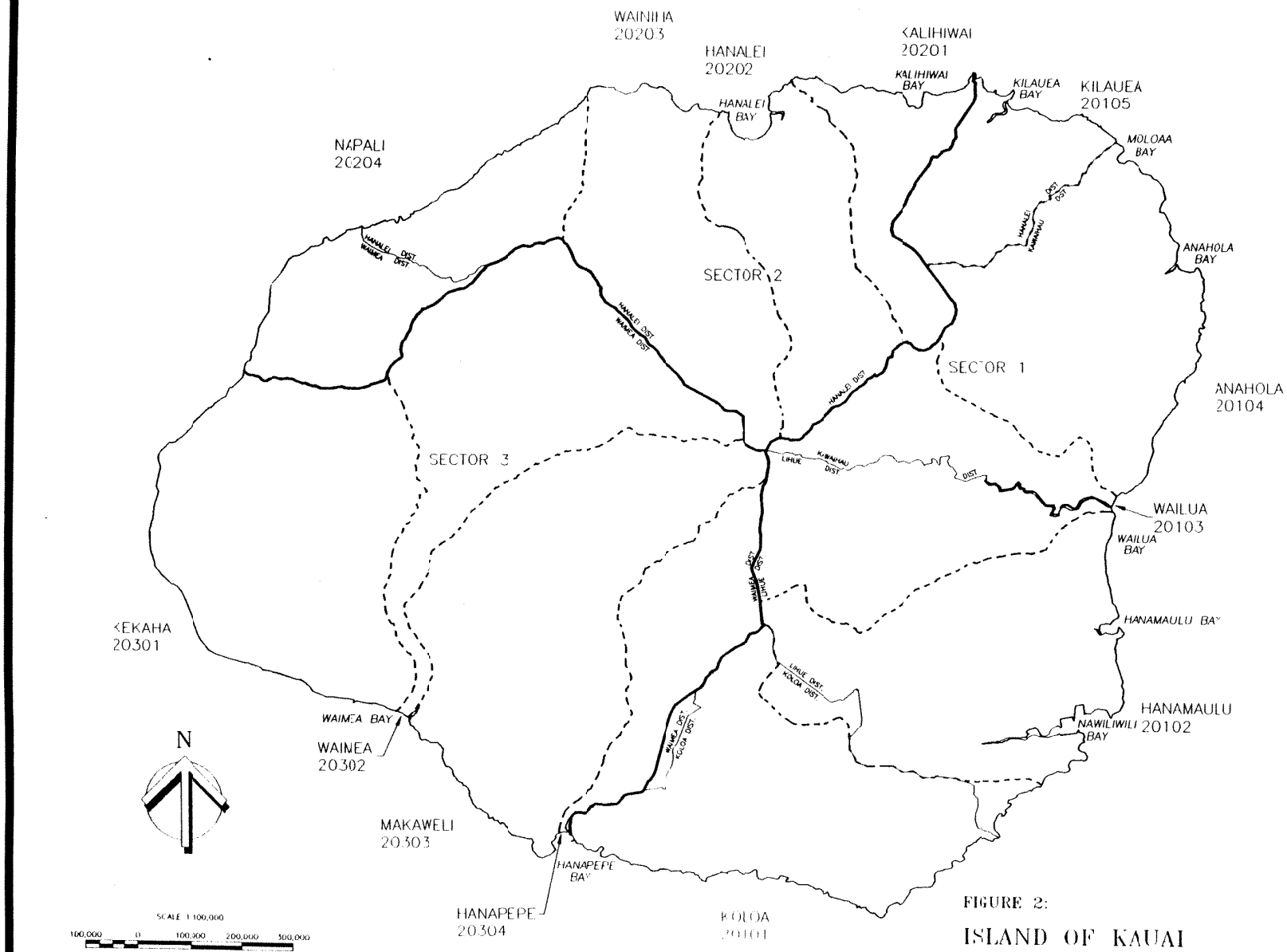

FIGURE 2:

ISLAND OF KAUAI
DISTRICT AND AQUIFER BOUNDARIES

3. System: An area within a Sector showing hydrogeological continuity. The systems are the hydrologic units used for the reporting water use and withdrawals in this report. The dashed lines in Figure 2 delineates the systems within the three sectors.
4. Type: Portions of a System of a distinct hydrogeological type (high level groundwater, etc.).

Islands are coded by number in according to the U.S. Geological Survey (1975) protocol. Island numbers are 1 (Niihau), 2 (Kauai), 3 (Oahu), 4 (Molokai), 5 (Lanai), 6 (Maui), 7 (Kahoolawe), and 8 (Hawaii). Each Aquifer Sector and System is coded with a two-digit number. Sectors and Systems are also assigned geographic names. Hawaiian place names are preferred; but for some Sectors the general locators North, South, East, and West or a traditional geographic term such as Windward, are required for clarity. All Systems have Hawaiian names. Aquifer Types are coded with a three-digit number which describe fundamental hydrology and geology.

2.5.1 Hydrology

Following is a table of the Aquifer Codes for the Island of Kauai along with Sector and Aquifer System names. Kauai includes 3 Sectors and 13 Aquifer Systems. (see Figure 2).

Sector		System		Aquifer Code
Lihue	01	Koloa	01	20101
		Hanamaulu	02	20102
		Wailua	03	20103
		Anahola	04	20104
		Kilauea	05	20105
Halelea	02	Kalihiwai	01	20201
		Hanalei	02	20202
		Wainiha	03	20203
		Napali	04	20204
Waimea	03	Kekaha	01	20301
		Waimea	02	20302
		Makaweli	03	20303
		Hanapepe	04	20304

2.6 POPULATION ANALYSIS

The County of Kauai has a growing economy based on the sugar industry and tourism. Provisional estimates for 1987 indicate a State of Hawaii resident population of 1,082,500 of which 47,400 or approximately 4 percent are in the County of Kauai. This estimate includes members of the armed forces stationed in or homeported in Hawaii and residents temporarily absent, and excludes visitors present.

Total resident population for the County of Kauai has increased approximately 7.1 percent from 1960 to 1970; 31.3 percent from 1970 to 1980; and 16.8 percent from 1980 to 1987.

According to the County of Kauai's Office of Economic Development, 1987 resident population figures for the five district areas on Kauai were: Waimea District - 8,907; Koloa District - 11,056; Lihue District - 9,726; Kawaihau District -13,002; Hanalei District - 4,709.

According to the Office of Economic Development, the 1986 ethnic makeup of the County of Kauai was as follows:

Caucasian	29.4
Japanese	23.2
Filipino	26.4
Hawaiian and part Hawaiian	15.2
Chinese	1.2
Other	4.6

According to the U.S. Bureau of Census, the County of Kauai had a 1985 estimate of 14,300 households with an average persons per household of 3.14. This represents a 19.0 percent increase over the 1980 census figure of 12,020 households with an average persons per household of 3.22.

The civilian labor force for the County of Kauai in 1987 was estimated at 25,000, and civilian employment was 23,900. an estimated 1,100 or 4.4 percent of the labor force was unemployed.

2.7 ECONOMIC ANALYSIS

The major economic forces in the County of Kauai, as well as for the State of Hawaii, are tourism, construction, the military, agriculture, and manufacturing. A brief analysis describing each industry is given below.

2.7.1 Tourism

Tourism, as in the past, is Hawaii's leading economic force. Two million east bound visitors, mostly Japanese, came to Hawaii last year, a 17 percent increase over 1987. Of the Japanese who came to Hawaii in 1987, over 17 percent or approximately 275,000. spent their vacations on Kauai. The total east bound visitor count, through the first quarter of 1989, is up by 14 percent over last year. In spite of some cancellations among older Japanese travellers, a strong surge in younger Japanese travellers continues to boost the overall number of Japanese coming to Hawaii.

The Kauai west bound market was the only one to experience an increase in 1987 with over one million west bound visitors coming to Kauai, almost two percent more than

in 1986. This marks the fourth consecutive year of increase in Kauai's major visitor market.

Average daily visitor census in 1987 was 143,270 for the State of Hawaii, of which 15,510 or approximately 11 percent were in the County of Kauai. To accommodate these visitors, Kauai had an inventory in 1987 of 7,180 hotel and condominium units. Kauai's occupancy rate during 1988 was 74 percent, below the average for the State. The total preliminary estimated expenditures by visitors to Hawaii in 1987 was 6.6 billion dollars, of which $580 million or approximately 9 percent was spent on the County of Kauai.

2.7.2 Construction

Construction is now the second largest industry in terms of dollar valuations. In 1987, building permit valuations totalled $109 million, up by about 8 million from the year 1986. Following a sharp decline in 1985, the local construction industry entered into a growth phase which has continued through 1987. In 1987, single family construction valuations as well as additions and alterations valuations totalled more than $80 million dollars.

2.7.3 Military

The military is a small economic sector in the County of Kauai. As of 1987, there were 45,396 military personnel in the State with 129 stationed on Kauai. The military also generates 95 civilian jobs on Kauai. As of the third quarter of 1988, direct contributions to the State economy by the military came to $1.5 billion, excluding naval contract purchases from local businesses. A majority of these funds were spent on Oahu, making the military a small contributor to Kauai's economy.

2.7.4 Agriculture

In 1987, three of the island's sugar companies enjoyed moderate success, the remaining two sustained losses. Aggregate production figures were down to 229,088 tons in 1987 as compared with 241,00 tons in 1986. Poor weather conditions among other factors contributed to the decline. Lihue Plantation, traditionally the largest producer sustained the greatest loss in 1987.

Even while the sugar companies continue efforts to improve operations, they look to diversify its agricultural operations, to include other commodities. McBryde, Kekaha and Lihue Plantations have made in roads in this area, looking into such crops as coffee, tea, cocoa and foliage. McBryde has moved fastest in diversification efforts with its plantings of macadamia nut trees. The first harvest was supposedly started in 1987 on a 17-acre plot that was planted in 1984.

In the past five years, diversified agriculture has demonstrated positive advances in the

local economy. While not all commodities succeeded during this period most have. Particularly hard hit has been the papaya industry. With less than 10 farmers in the Moloaa Farmers Cooperative, papaya production dropped to less than 2 million pounds in 1987. Also hurt was the banana industry, with about 1.5 million pounds of production. With better varieties now coming on line, the William Hybrid variety is finding a difficult go of it especially in the Honolulu markets.

However, even with these setbacks the value of livestock and crop sales for Kauai in 1986 totalled $11.7 million. We estimate that the figure for 1978 was even higher. Leading the way has been the guava industry on Kauai. Over 10 million pounds were harvested in 1987.

With an additional 150 acres of orchard planted, Kilauea Agronomics can expect to almost double its production by 1990. Because of the expansion of the guava industry, the value of processed fruits grown on Kauai has increased more than four fold since 1980. Further increases are anticipated. The island has not yet maximized its potential in growing of fruits. With the growth of papayas, and other tropical fruits such as mangos, lychees and with growing of exotic fruits, the dream of Kauai as a fruit basket can be fulfilled. Another area fulfilling its potential is the flower and nursery products industry. The value of foliage and flowers has more
than doubled since 1983.

2.8 LAND USE

The three major determinants of land use in the County of Kauai are the State Land Use District Classifications, the County General Plan and the County of Kauai's Land Use Ordinance (zoning codes). The County of Kauai is divided into five districts: Waimea-Kekaha, Koloa, Lihue, Kawaihau and Hanalei.

2.8.1 State of Hawaii Land Use District Classification

The State of Hawaii Land Use District includes four classifications: "U" Urban, "A" Agricultural,"C" Conservation and "R" Rural. Urban districts are characterized by "city-like" concentrations of people, structures, streets, urban level of services and other related land uses. Agricultural districts include lands with a high capacity for agricultural production. Conservation districts preserve and protect lands for watersheds and environmental resources, for public safety as with flood zones, for parks and recreation, and for scenic views. Rural districts are characterized by lower density uses than the urban land use districts.

The State Land Use for the Island of Kauai includes; 12,391 acres or 4 percent of the land in Urban Land Use District, 141,544 acres or 45 percent of the land in Agricultural Land Use District, and 198,732 acres or 56 percent of the land in Conservation Land Use District and 1,233 acres or less than half a percent in Rural Land Use District.

2.8.2 County of Kauai General Plan Designations

The County shares responsibility with the State Land Use Commission for regulating uses within areas designated Rural and Agriculture by the State. Within the State Conservation Districts, the State Land Use Board has sole zoning jurisdiction and authority. Within areas designated for Urban or Rural uses, the County has full zoning responsibility.

The County's land use regulation system is headed by the General Plan which currently designates specific types of uses for all parcels. The types of uses, called General Plan Land Use Designations, distinguish between specific urban uses such as commercial, industrial, multi-family residential and single-family residential, and non-urban uses such as agriculture and open. To implement General Plan Land Use Designations, zoning is required.

The estimated acreage of the basic land use units for the General Plan are:

PF	Public Facilities	3,800 acres
R	Resort	2,860 acres
UMU	Urban Mixed Use	3,360 acres
UR	Urban Residential	7,520 acres
RR	Rural Residential	2,100 acres

Note: The other areas are in agricultural, conservation and open designated areas.

2.8.3 County of Kauai Comprehensive Zoning Ordinance

The purpose of the County of Kauai CZO is to regulate land use to encourage orderly development in accordance with adopted land use policies, including the Kauai General Plan and Development Plans.

The CZO provides development and design standards for the location, height and size of structures, yard areas, off-street parking facilities, and open spaces, and the use of structures and open spaces, and the use of structures and land for agriculture, industry, business, residences or other purposes. Table 1 shows the acreage for the basic zoning districts by planning area. A more detailed acreage breakdown is provided in the Appendix.

2.9 COUNTY GENERAL PLAN AND LAND USE POLICIES

The Kauai County Charter was adopted in 1967. The Charter required the adoption by ordinance of a General Plan setting forth policies to govern the physical development of the County. The plan was to "serve as a guide to all future council action regarding land use and development regulations, urban renewal programs and expenditures for capital improvements." An amendment to the County Charter in 1976 required that the General Plan be adopted by ordinance and established as ordinance.

TABLE 1

KAUAI WATER USE DEVELOPMENT PLAN
COMPREHENSIVE ZONING ORDINANCE

Zoning Designation	ACRES ZONED FOR PLANNING AREA						
	Hanalei-North-Shore	Kapaa-Wailua	Lihue	Koloa-Poipu-Kalaheo	Hanapepe-Eleele	Waimea-Kekaha	TOTAL
Residential	803.7	1994.5	870.5	2041.6	385.7	676.3	6772.3
Resort	99.1	104.0	92.0	84.1	0.0	0.0	379.2
Commercial	72.7	65.3	273.2	72.8	47.8	27.6	559.4
Industrial	5.1	40.7	205.6	0.0	34.2	26.1	311.7
Project District - Cultural	0	0.0	0.0	12.3	0.0	1.4	13.7
	980.6	2204.5	1441.3	2210.8	467.7	731.4	8036.3

Note: Agricultural and Open zoned lands are not included in this estimate.

The County of Kauai formulated and adopted a General Plan in 1971. This plan provided needed guidance to the County which desired to grow and prosper with the rest of the counties in the State. Since then, there have been relatively minor amendments to the land use policies of the General Plan.

In 1981, the County initiated a General Plan Update to review, evaluate, and make changes as necessary and desirable to the current General Plan.

The goals of the General Plan was modified slightly as follows:

- To maintain the concept of Kauai as "The Garden Isle"; thus, insisting any growth be in consonance with the unique landscape and environmental character of the island.

- To insure that all physical growth is consistent with the overall ecology of the island.

- To manage growth according to established population growth targets.

- To create opportunities for a greater fulfillment of life through the development of a broad spectrum of educational and cultural pursuits.

- To promote and protect the health, safety an welfare of all residents and visitors.

- To provide opportunities for suitable living quarters for all residents in all income levels.

- To provide for a maximum variety of outdoor recreational activities.

- To recognize those aspects of the island and its people which are historically and culturally significant, and to maintain and enhance such aspects as a continuing expression of the island's physical and social structure.

- To promote the improvement and expansion of the island's economy, by recognizing and carefully utilizing land and water resources.

- To guide and control development to take full advantage of the island's form, beauty and climate and preserve the opportunity for an improved quality of life.

- To guide physical growth so that island and visitor communities will develop in social and economic concert with each other.

- To manage implementation through development of social and physical infrastructure based on growth targets, priorities and efficient utilization of facilities and services.

- To provide workable planning tools to meet the changing needs of the community.

- To create, develop and sustain an economy and a population composition that will encourage the youth of Kauai to live in the County and contribute to society.

- To encourage and support efforts to approach self sufficiency in food production and energy.

2.10 FUTURE PROJECTIONS

2.10.1 Population Projections

The State Department of Business and Economic Development (DBED) in November 1988 issued its newly revised economic and population projections for Hawaii designated series "M-K." This series covers the period from 1985 to 2010 and constitutes the official population and economic projections for the State of Hawaii.

The M-K projections anticipate that the resident population of the County of Kauai will rise 86 percent from 45,400 in 1985 to 86,900 in 2010. Kauai will account for 6 percent of the total State resident population of 1,435,500 in 2010, up from 4 percent of the 1985 State total of 1,051,500.

The de facto population of the County of Kauai which includes visitors, is expected to increase 121 percent from 56,200 in 1985 to approximately 124,500 in 2010. Kauai will contribute 7 percent of the State's total de facto population in 2010, up from 5 percent in 1985. Table 2 shows the projected increase in population from 1990 to 2010 and the areal distribution of the population in 2010, based upon zoning.

2.10.2 Economic Projections

The two major economic forces in the County of Kauai, as well as in the State of Hawaii, will continue to be tourism, and agriculture, primarily sugar exports. A brief analysis of projections for each industry is given below.

Tourism. Tourism, as in the past, will continue to be a leading economic force in Hawaii. In 1987, the average daily visitor count was 15,500 for the Island of Kauai. The projections for this figure is expected to increase by almost 97 percent State-wide in 2010. The primary resort area on Kauai will continue to be the Koloa-Poipu area.

Agriculture. According to the DBED's Series M-K, raw sugar, one of Hawaii's primary agricultural crops, is anticipated to decrease in export value from a State-wide total of $330 million in 1985 to approximately $230 million in 2010. This amounts to a slight but consistent annual decline averaging about 1.5 percent through 2010. Productivity gains will also likely continue in sugar,resulting in employment declines averaging 2.5 percent per year from 1990 to 2010.

The market for Hawaii sugar is currently assured by the price support provisions of the 1985 Food Security Act through December 1989, assuming that Hawaii sugar production is competitive in the marketplace and that high fructose corn syrup does not

TABLE 2

Kauai Water Use and Development Plan
POPULATION PROJECTIONS

YEAR	(1) RESIDENT	VISITOR	(2) DEFACTO
1990	51,800	18,300	70,100
1995	59,500	22,200	81,700
2000	67,900	26,100	94,000
2005	76,800	28,000	104,800
2010	86,900	37,600	124,500

AREAL POPULATION DISTRIBUTION (2010) BY ZONING

AREA	(1) RESIDENT	VISITOR	TOTAL
HANAPEPE, WAIMEA	11,300	527	11,827
KOLOA	19,970	12,390	32,360
LIHUE	20,860	8,542	29,402
KAWAIHAU	22,600	8,309	30,909
HANALEI	12,170	7,833	20,003

AREAL POPULATION DISTRIBUTION (2010) BY GENERAL PLAN

AREA	(1) RESIDENT	VISITOR	TOTAL
HANAPEPE, WAIMEA	15,909	1,666	17,575
KOLOA	27,916	8,799	36,715
LIHUE	16,882	7,417	24,299
KAWAIHAU	22,165	5,840	28,005
HANALEI	4,027	13,878	17,905

1 KAUAI DEPARTMENT OF ECONOMIC DEVELOPMENT
2 HAWAII STATE DATA BOOK

displace sucrose by an additional 1,000,000 tons, which is approximately the current amount imported. Beyond that point there will either be need for a quota system for domestic sucrose producers or part of the sales potentials will be lost to the highest cost domestic producers, possibly including Hawaii. If the 1985 support program is not renewed, most domestic producers, including Hawaii, will not be able to compete in the marketplace against surplus sugar that is dumped on the world market at prices far below costs of production.

SECTION 3

EXISTING WATER USE AND DEVELOPMENT

3.1 OVERVIEW OF WATER USE ON KAUAI

On Kauai, most of the water used for urban activities is derived from groundwater sources. Surface water has not been extensively used because of the ready availability of an excellent supply of groundwater. According to water use data compiled by the Department of Water, there was an estimated 423.4 million gallons per day (mgd) of water used on Kauai, in 1988. Of this total, groundwater sources accounted for 60.0 mgd, or 14 percent of the total withdrawals of water use. Surface water sources, primarily agricultural diversions, used 363.4 mgd, or approximately 86 percent of the total. Recycled water for agriculture used 15 mgd, less than four percent of the total water use on Kauai.

The major users of Kauai water include the sugar plantations, the Kauai Department of Water (DOW), private industry, diversified agriculture, and other private users who develop water for their own consumption. The DOW is the major supplier of potable water for nearly all residential and urbanized uses on Kauai. Table 3 shows the estimated amount of water used on Kauai in 1988.

Of the total estimated withdrawals of 423.4 mgd in 1988 from mostly surface sources, the sugarcane plantations used the most water, 355.2 mgd, or 84.0 percent of all water withdrawn on Kauai. The DOW withdrew 10.5 mgd or 2.5 percent. The 10.5 mgd figure includes the use of Princeville which is a private system that is connected to portions of the DOW system. Military use amounted to a minimum amount in 1988, and miscellaneous private wells for agricultural, industrial and domestic use consumed 13.5 percent of the water.

3.2 AVAILABLE WATER SUPPLY

Kauai's abundant groundwater and surface water supply is an important natural resource that has contributed significantly to the economic growth of the island. Rainfall is the sole source of freshwater and its quantity and spatial distribution govern the volume and quality of the groundwater and surface water. Mean annual rainfall on Kauai ranges from less than 20 inches to 400 inches on Mount Waialeale. Groundwater recharge is estimated to be 30 percent of rainfall by the USGS.

As part of the upcoming Hawaii Water Plan, a study was commissioned to determine the sustainable yields of surface and groundwater sources Statewide. George Yuen and Associates (1989) have completed estimating the sustainable yield for all groundwater aquifers on Kauai. The yields represent an estimate of the rate of total pumpage which could be continuously withdrawn from an aquifer without affecting either the quality or quantity of the output. Sustainable yields are derived from predevelopment water

TABLE 3

WATER USE ON KAUAI
1988

	Quantity (mgd)	Percent
Board of Water Supply (1)	10.5	2.5
Sugarcane Plantations (2)	355.2	84.0
Private Use & Industrial (3)	57.7	13.5
	423.4	100

(1) DOW records, includes Princeville water use
(2) DOWALD and sugar companies
(3) DOWALD and miscellaneous sources. Includes unverified data from State water registration forms.

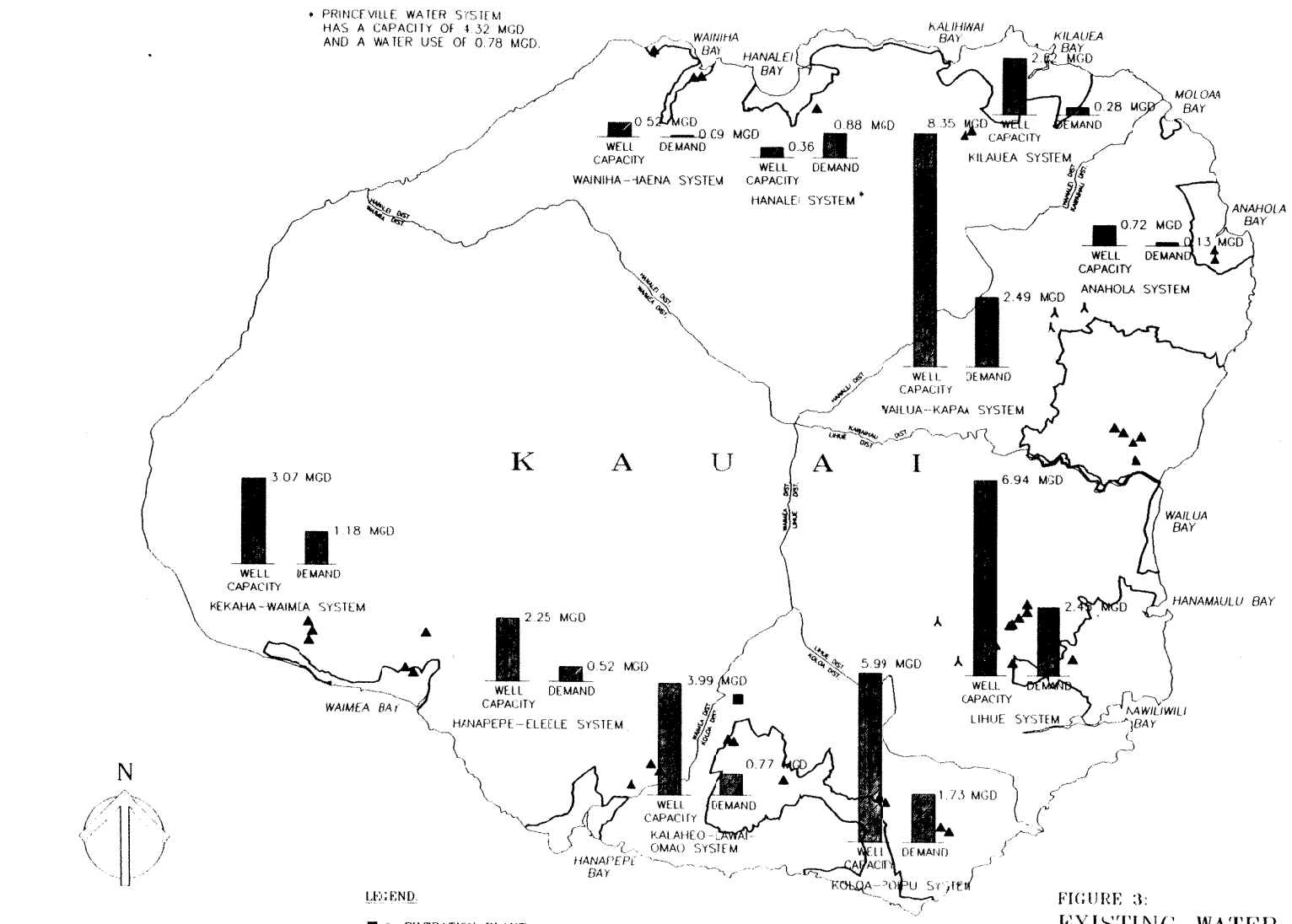

FIGURE 3:
EXISTING WATER DEMAND & WELL CAPACITIES PER MUNICIPAL SYSTEM

balances and groundwater behavior over a period of time, and are only estimates to be used as general guidelines at this time. Predevelopment refers to the hydrologic conditions of the Island of Kauai before the introduction of urbanization and agricultural activities. Thus, the impacts of agricultural transport of water and aquifer recharge due to irrigation practices have yet to be taken into account. The amount of data available is limited at this time. As further studies are done, the estimates of sustainable yield will increase in accuracy. At this time the estimates provide accuracy to the right order of magnitude and should be used as guidelines to define the high priority areas for further study.

A water balance analysis was used to estimate the sustainable yields used in the State Water Resources Protection Plan. A balance was established between the only source of water in a hydrologic unit, rain, and the water leaving the hydrologic unit. Water leaves the hydrologic unit by evaporation, consumption by plants or transpiration and runoff from streams and rivers. The remaining portion of the rain water percolates into the ground where it can recharge the various types of groundwater aquifers. Of this amount that percolates into the ground, a portion is available for consumption. This portion available for consumption is the sustainable yield for groundwater.

Some groundwater will reappear as surface water, such as springs, which increases the total amount of surface water in rivers and streams. This interaction between surface and ground water makes it more difficult to determine the sustainable yield for surface water. The surface water estimates in this report are very approximate. The consumption of water by man through wells, tunnels and stream diversions for domestic, industrial, commercial and agricultural uses changes the natural hydrologic patterns used in the sustainable yield estimates. Irrigation practices divert water that would normally have flowed to the ocean and place it on crop fields, a portion of which percolates back into the ground to recharge the groundwater aquifers. This will affect the sustainable yield estimates. Additional studies will have to be done to take these factors into account.

The sustainable yields of groundwater for the Aquifer Systems of Kauai are difficult to estimate because of the complex relationships among the various types of groundwater and between groundwater and surface water. Wherever the Koloa volcanics are the dominant rock type, perched groundwater is widespread in discontinuous aquifers and masks the presence of basal water. Beneath the aquifers in the Koloa formation, high level and basal groundwater may exist in the basement rock of the Napali volcanics. Adding to the uncertainties of water provenance are numerous large perennial streams which drain high level and perched aquifers.

For all aquifer systems on Kauai, the sustainable yield for groundwater sources is estimated at 388 mgd. The Wailua aquifer has the greatest supply at 60 mgd or 15 percent of the total. The appendix presents a detailed listing of water use by hydrologic unit and presents the same listing by Water System area. A further discussion on the accuracy of the sustainable yield estimates is provided in the Appendix.

Of the total of 388 mgd groundwater sustainable yield islandwide, an estimated 60 mgd was withdrawn in 1988. This leaves a remainder of 328 mgd of available groundwater

supply to accommodate future demands. Within individual aquifers, however, there is substantial variation with some aquifers having significant withdrawals over sustainable yield. The Kekaha aquifer is estimated to be overdrawn by 7.52 mgd, see Figure 5, but all other aquifers show significant surplus. The estimated overdraft of 7.52 mgd is not occurring at this time according to physical evidence. The discrepancy between the estimated sustainable yield and the actual field experience is a function of the limited hydrologic information available upon which the sustainable yield estimates were based. The estimate indicates that further study of this area is necessary and further controls may be required but there is no indication that the aquifer is being compromised or overdrawn at this time. The Waimea, Makaweli and Hanapepe hydrologic units show an inadequate sustainable yield when compared to surface water withdrawn. Since the sugar companies adjust their irrigation practices to the water available, this is not expected to be a problem. Figure 5 shows the existing water use, withdrawal and sustainable yields. Water use describes the amount of water used for domestic or agricultural purposes within a hydrologic unit. The water can come from the same unit or be transported from another hydrologic unit. Water withdrawal describes the actual removal of water from the hydrologic unit for these purposes. Withdrawals directly impact the sustainable yield of a hydrologic unit. The sustainable yield estimates are provided for comparison only.

3.3 MUNICIPAL SYSTEMS - DEPARTMENT OF WATER

The Department of Water (DOW) of the County of Kauai is a semi-autonomous agency responsible for the management, control, and operation of Kauai's municipal water system. The DOW is entirely self-supporting from water sales revenues.

3.3.1 DOW Water Sources and System

To facilitate its planning and administration, the DOW has divided Kauai into thirteen water service districts: Kekaha, Waimea, Hanapepe-Eleele, Kalaheo, Lawai-Omao, Koloa-Poipu, Lihue, Wailua-Kapaa, Anahola, Moloaa, Kilauea and Anini, Hanalei and Haena-Wainiha. These service areas correspond somewhat with the hydrologic systems.

As of 1988, the DOW maintained 47 separate groundwater sources comprised of wells, shafts, and tunnels. The DOW has well fields containing a total of 39 wells. Seven stations consist of shafts with horizontal collecting tunnels. One stream diversion at Alexander Dam provides a local supply for the Kalaheo.

3.3.2 DOW Quantity and Quality of Water Use

Of the 9.73 mgd withdrawn by the DOW in 1988, 99 percent was from groundwater sources. The remaining one percent is from stream spring water. The Princeville system, which makes up the remaining 0.77 mgd, derives its water from groundwater sources. Figure 3 shows the existing municipal water use on Kauai by major systems.

TABLE 4

Kauai Water Use and Development Plan
EXISTING WATER USE SUMMARY
Ground Water Used in Hydrologic Unit

Hydrologic System		Ground Water Used (MGD) Municipal /Other	Irrigation	Total	Ground Sustainable Yield (MGD)
Koloa	20101	5.91	26.02	31.93	30
Hanamaulu	20102	1.01	3.35	4.36	40
Wailua	20103	0.33	0.21	0.54	60
Anahola	20104	0.14	2.41	2.55	36
Kilauea	20105	0.19	0.00	0.19	17
Kalihiwai	20201	0.61	0.00	0.61	16
Hanalei	20202	0.37	0.00	0.37	35
Wainiha	20203	0.09	0.00	0.09	24
Napali	20204	0.00	0.00	0.00	20
Kekaha	20301	0.90	19.17	20.07	12
Waimea	20302	0.28	0.00	0.28	42
Makaweli	20303	0.26	2.15	2.41	30
Hanapepe	20304	0.15	0.00	0.15	26

Municipal figures show the water used by the Department of Water Supply for Kauai County. Other water use reflects water used by private domestic water systems. Irrigation figures list the water used by agricultural activities. Total use is the sum of the Municipal/Other and Irrigation use.

Sustainable Yields represent an estimate of the rate of total pumpage which can be continuously drawn from a system without affecting either the quality or quantity of the output. Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water used in a hydrologic unit describes where water is actually utilized for domestic or irrigation purposes. Water use does not directly impact the sustainable yield of a hydrologic unit as water could be withdrawn and transported from another hydrologic unit.

TABLE 5

Kauai Water Use and Development Plan
EXISTING WATER USE SUMMARY
Surface Water Used in Hydrologic Unit

Hydrologic System		Surface Water Used (MGD) Municipal /Other	Irrigation	Total	Surface Sustainable Yield (MGD)
Koloa	20101	0.50	28.52	29.02	21.7
Hanamaulu	20102	0.00	26.08	26.08	34.2
Wailua	20103	0.00	43.61	43.61	147.4
Anahola	20104	0.00	35.91	35.91	30.9
Kilauea	20105	0.00	6.89	6.89	16.8
Kalihiwai	20201	0.00	0.11	0.11	30.3
Hanalei	20202	0.00	13.15	13.15	151.5
Wainiha	20203	53.89	8.29	62.18	252.4
Napali	20204	0.00	0.00	0.00	12.8
Kekaha	20301	0.00	52.53	52.53	2.8
Waimea	20302	0.00	5.78	5.78	43.8
Makaweli	20303	0.00	77.58	77.58	22.6
Hanapepe	20304	0.00	7.02	7.02	43.6

Municipal figures show the water used by the Department of Water Supply for Kauai County. Other water use reflects water used by private domestic water systems. Irrigation figures list the water used by agricultural activities. Total use is the sum of the Municipal/Other and Irrigation use.

Sustainable Yields represent an estimate of the rate of total pumpage which can be continuously drawn from a system without affecting either the quality or quantity of the output. Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water used in a hydrologic unit describes where water is actually utilized for domestic or irrigation purposes. Water use does not directly impact the sustainable yield of a hydrologic unit as water could be withdrawn and transported from another hydrologic unit.

DOW, with assistance of DOH, monitors the quality of domestic water to ensure it is safe to drink in conformance with the State's Safe Drinking Water regulations. Approval from the State Department of Health must be obtained before any new drinking water source is used. All DOW potable water sources meet DOH and Environmental Protection Agency water quality standards.

3.4 AGRICULTURAL SYSTEMS

Agricultural users of water on Kauai consist primarily of plantation irrigation of sugarcane fields. Other diversified agricultural pursuits also use considerable water, including taro, macadamia and other vegetables, coffee, melons, and fruits.

3.4.1 Sugarcane

The largest use of water on Kauai is for the irrigation of sugarcane plantations. Sugarcane requires enormous quantities of water, nearly 1.5 tons of water is required to produce one pound of sugar. Sugarcane yields are highest where sugarcane is irrigated, and water use has been estimated at 600,000 to 1,000,000 gallons per day per 100 acres. Plantation sugarcane companies utilized approximately 355.2 mgd for irrigated sugarcane, about 99 percent of all surface water utilized in 1988 on Kauai. Figure 4 shows the existing plantation ditch systems. The shaded areas denote the cane fields. Figure 5 shows the existing municipal and irrigation water demands by hydrologic unit. Tables 4 and 5 show the existing amount of ground and surface water used, respectively, in a hydrologic unit, and Tables 6 and 7 show the amount of ground and surface water withdrawn, respectively, from a hydrologic unit. It should be noted that the water use figures do not directly impact upon the sustainable yields of the given hydrologic units. The withdrawal figures, however, are directly related to the sustainable yield figures. Water use and withdrawals are shown on Figures 5, 7 and 9 to graphically depict the areal distribution of water use.

Sugarcane is grown on approximately 39,000 acres. The major plantations on Kauai are the Lihue Plantation Company which cultivates 15,000 acres of land, Kekaha Sugar Company which cultivates on 8,400 acres, McBryde Sugar Company which cultivates on 8,000 acres, Olokele Sugar Company which cultivates 4,800 acres and Gay and Robinson which cultivates 2,800 acres. Acreage under cultivation have gradually declined over the years due to falling sugar prices, increased use of artificial sweeteners, and some urbanization of sugarcane lands. Acreage in sugarcane will be declining as the major growers shift to other crops.

Most of Kauai's sugarcane lands are irrigated, and these lands produce most of Kauai's sugar. Irrigation is primarily by furrow and drip systems. Water use has declined, aided by the conversion to drip irrigation (6,000 gpd per acre) from furrow irrigation (10,000 gpd per acre). With furrow irrigation, the entire field must be wetted to achieve wetting the sugarcane root zone. With drip irrigation, water is applied only to the root zone area of the plant. The fields are watered using subsurface plastic tubes perforated with tiny holes. Drip irrigation is now used extensively on Kauai, except for Lihue Plantation, on irrigated fields to allow more efficient watering and fertilizing, higher

TABLE 6

Kauai Water Use and Development Plan
EXISTING WATER USE SUMMARY
Ground Water Withdrawn from Hydrologic Unit

Hydrologic System		Ground Water Withdrawn (MGD) Municipal /Other	Irrigation	Total	Ground Sustainable Yield (MGD)
Koloa	20101	5.91	10.34	16.25	30
Hanamaulu	20102	1.01	3.35	4.36	40
Wailua	20103	0.33	0.00	0.33	60
Anahola	20104	0.14	2.62	2.76	36
Kilauea	20105	0.28	0.00	0.28	17
Kalihiwai	20201	0.79	0.00	0.79	16
Hanalei	20202	0.11	0.00	0.11	35
Wainiha	20203	0.09	0.00	0.09	24
Napali	20204	0.00	0.00	0.00	20
Kekaha	20301	0.35	19.17	19.52	12
Waimea	20302	0.83	0.00	0.83	42
Makaweli	20303	0.26	2.15	2.41	30
Hanapepe	20304	0.15	15.68	15.83	26

Municipal figures show the water withdrawn by the Department of Water Supply for Kauai County. Other water withdrawn reflects water withdrawn by private domestic water systems. Irrigation numbers list the water withdrawn for agricultural activities. Total water withdrawn is the sum of the Municipal/Other and Irrigation figures.

Sustainable Yields represent an estimate of the rate of total pumpage which can be continuously drawn from a system without affecting either the quality or quantity of the output. Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water withdrawn from a hydrologic unit describes the water taken from a hydrologic unit by well pumping, tunnels, or stream diversions for domestic or agricultural uses.

TABLE 7

Kauai Water Use and Development Plan
EXISTING WATER USE SUMMARY
Surface Water Withdrawn from Hydrologic Unit

Hydrologic System		Surface Water Withdrawn (MGD) Municipal /Other	Irrigation	Total	Surface Sustainable Yield (MGD)
Koloa	20101	0.50	12.03	12.53	21.7
Hanamaulu	20102	0.00	7.22	7.22	34.2
Wailua	20103	0.00	60.52	60.52	147.4
Anahola	20104	0.00	25.63	25.63	30.9
Kilauea	20105	0.00	6.89	6.89	16.8
Kalihiwai	20201	0.00	0.11	0.11	30.3
Hanalei	20202	0.00	30.61	30.61	151.5
Wainiha	20203	53.89	8.29	62.18	252.4
Napali	20204	0.00	0.00	0.00	12.8
Kekaha	20301	0.00	0.53	0.53	2.8
Waimea	20302	0.00	57.78	57.78	43.8
Makaweli	20303	0.00	51.58	51.58	22.6
Hanapepe	20304	0.00	44.28	44.28	43.6

Municipal figures show the water withdrawn by the Department of Water Supply for Kauai County. Other water withdrawn reflects water withdrawn by private domestic water systems. Irrigation numbers list the water withdrawn for agricultural activities. Total water withdrawn is the sum of the Municipal/Other and Irrigation figures.

Sustainable Yields represent an estimate of the rate of total pumpage which can be continuously drawn from a system without affecting either the quality or quantity of the output. Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water withdrawn from a hydrologic unit describes the water taken from a hydrologic unit by well pumping, tunnels, or stream diversions for domestic or agricultural uses.

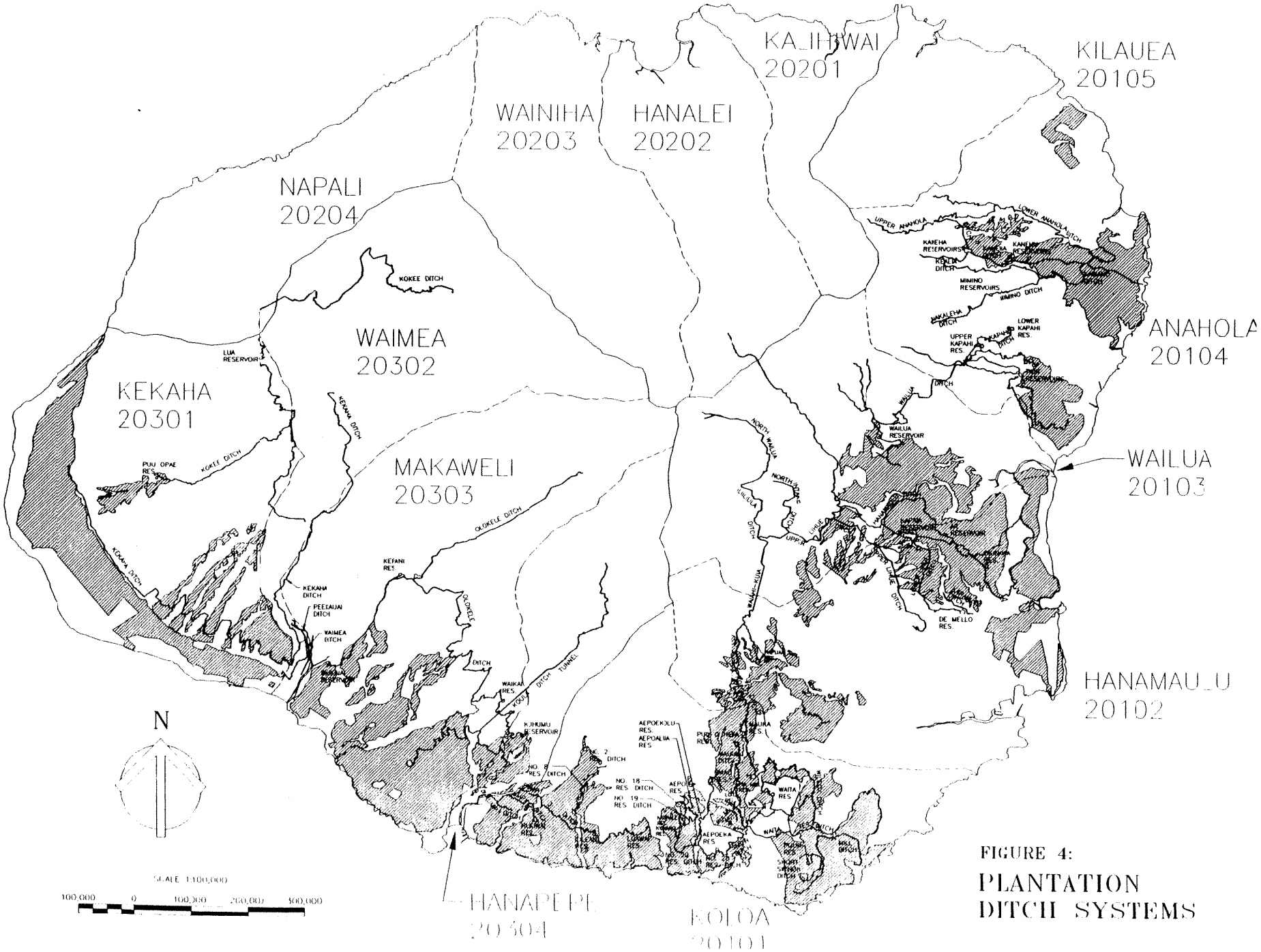

FIGURE 4:
PLANTATION
DITCH SYSTEMS

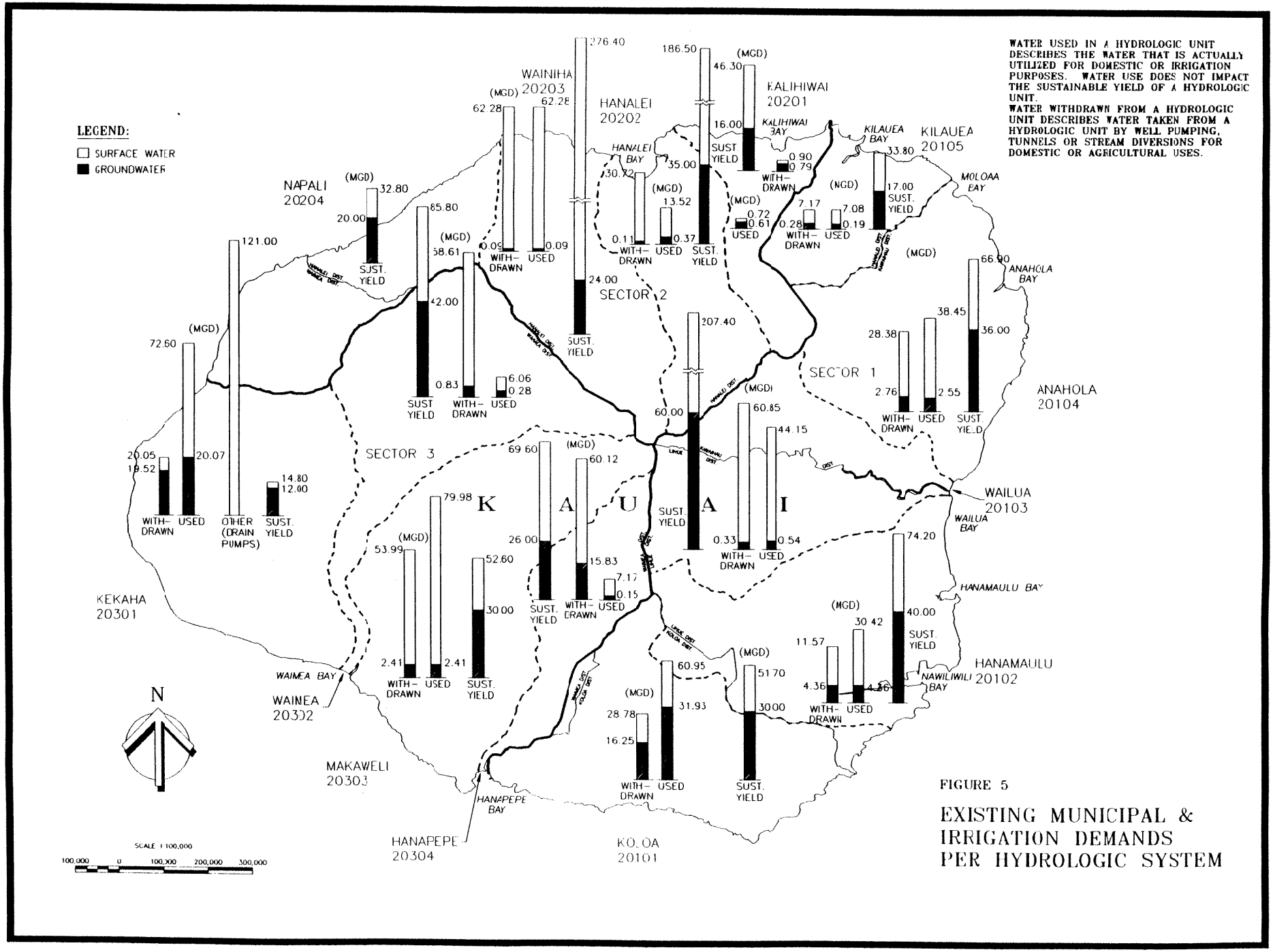

FIGURE 5

EXISTING MUNICIPAL & IRRIGATION DEMANDS PER HYDROLOGIC SYSTEM

yields, use of steeper mauka lands, and less labor.

In 1988, Lihue Plantation Company pumped less than 1.0 mgd. The primary source of water used by Lihue Plantation is from surface water. Approximately 85 mgd of use was registered in 1988. Data was not available for all water sources used by the Plantation. The Plantation has a capacity to use over 150 mgd based on the 10,000 gpd per acre figure used for furrow irrigation. Approximately 17.5 mgd of water was transported from the Hanalei side via the Hanalei Ditch to irrigate the fields in Lihue and Wailua. The ditch has a capacity of 30 mgd.

In 1988, McBryde Sugar Company withdrew 26 mgd from its wells in the Hanapepe and Koloa area to irrigate its sugarcane fields. Surface water sources totalled 45 mgd, including 17.0 mgd from the Hanapepe River. It should also be noted that some of McBryde Sugar's cane lands mauka of Koloa are unirrigated.

The Kekaha Sugar Company withdrew approximately 18 mgd from its wells in the Kekaha area in 1989. Surface water flows totalled approximately 53 mgd from the Kokee and Waimea Ditch Systems. The pumping in the area fluctuates seasonally and the Kekaha Sugar Company' pumping is facilitated by recharge from the water brought to the area by the Kokee and Waimea Ditch. This recharge and its effects upon the hydrology of the area will require additional studies to see if it has a significant impact on the groundwater aquifer. According to the sustainable yield estimates for the area, the Kekaha aquifer would appear to be sensitive to excess pumping.

The Olokele Sugar Company withdrew approximately 2 mgd from its wells in the Kaumakani area. The surface water flows totalled approximately 36 mgd. The Olokele Sugar Company receives water from the Gay and Robinson Company also. The Gay and Robinson Company registered approximately 54 mgd of surface water use in 1988. Of this amount a portion must be diverted to Olokele Sugar by mutual agreement.

3.5 MILITARY SYSTEMS

Military personnel comprise a portion of the population of Kauai. Most military activities are located at the Pacific Missile Range Facility in Mana, Kauai. The facility has its own water system and also supplements it system with water purchased from the DOW.

3.6 PRIVATE DOMESTIC, COMMERCIAL, AND INDUSTRIAL SYSTEMS

Private domestic, commercial, and industrial systems encompass a relatively minor category of self-supplied users of Kauai's water sources, except for the Kilauea and Princeville water system.

Industrial water supplies are provided by both the municipal DOW system and by private industrial systems. A few major industries, such as sugar processing, provide their own water supplies, and the balance, mostly smaller businesses, rely on the municipal system.

It is expected that future needs for major self-supplied industrial water would consist largely of increased requirements for electric power generation. Wash water used by sugar mills are now largely recycled to irrigate adjacent canefields.

A major independent water system has been established in Princeville community. The Princeville System serves domestic and commercial water needs for the Princeville community including residences, resort areas and small shopping areas. The system is supplied by 2 wells which feed the DOW distribution system and is delivered to Princeville's private distribution system. Domestic and commercial water use for Princeville is approximately 0.7 mgd.

There are other private systems such as the Polihale State Park Water System, Kokee Water System, Mana Water System, Kekaha Camp Water System, Pakala and Kaawanui Water Systems, Kaumakani Water System, Wahiawa Water System, Koloa Camp Water System and Kealia Water System.

SECTION 4

FUTURE WATER NEEDS

4.1 MUNICIPAL WATER DEMAND

Municipal water demand consists of water supply provided for Kauai customers of the Department of Water. These include the vast majority of residential, commercial, governmental and industrial users, as well as smaller agricultural farmers. A portion of the military water demand is also serviced by the Department of Water.

Future municipal water demand on Kauai is projected by major system areas and hydrologic unit up to the year 2010. The projects are based on the widely accepted population projections developed by the State Department of Business and Economic Development. The most recent Series M-K projections as modified by the Kauai County Department of Economic Development indicate a residential population for Kauai of 86,900 in the year 2010. This population total was distribution among the water system and hydrologic unit areas using the existing and future 2010 population distributions based on zoning.

Existing water consumption data were provided by the Department of Water for the water service areas established for its billing purposes. Differences between the DOW districts and the hydrologic units necessitated deriving some estimates in the distribution of population and water consumption.

The existing per capita consumption by hydrologic unit was used in projecting water demand for the planning period. A no increase or decrease in per capita consumption has been assumed through the planning period. Per capita consumption was provided by the DOW. The gallons per capita per day (gpcd) figures are; 187 gpcd for Waimea, 155 gpcd for Koloa, 202 gpcd for Lihue, 124 gpcd for Kapaa and 155 gpcd for Hanalei. Due to the large component of future demand of the Princeville development, the Princeville water demand is included in the projections for the Hanalei area.

Table 8 shows the actual and projected municipal water demand from 1990 to 2010 based on the above methodology.

Municipal and private potable water demand for Kauai is anticipated to increase from the current level of 10.51 million gallons per day (mgd) to 20.08 mgd by the year 2010. This represents a 91 percent increase over the planning period. Residential population during the period is expected to increase 72 percent, and de facto population by over 100 percent.

4.2 AGRICULTURAL WATER DEMAND

The future water demand for agricultural pursuits is dependent on the type of crops cultivated and the number of acres under cultivation. Principal among these on Kauai

TABLE 8

Kauai Water Use and Development Plan
WATER DEMAND SUMMARY (per Municipal System)

Municipal System	Well Cap. (MGD)	Water Demand (MGD) 1988	2010	Ultimate
Kekaha-Waimea	3.07	1.18	1.19	2.89
Hanapepe-Eleele	2.25	0.52	1.02	2.48
Koloa-Poipu	5.99	1.73	3.56	6.94
Kalaheo-Lawai	3.99	0.77	1.46	2.85
Lihue	6.94	2.45	5.92	8.59
Wailua-Kapaa	8.35	2.49	3.65	5.62
Anahola	0.72	0.13	0.18	0.28
Kilauea	2.02	0.28	0.45	0.82
Hanalei-Princeville	0.36	0.88	2.41	4.36
Wainiha-Haena	0.52	0.09	0.24	0.43
TOTALS:	34.21	10.52	20.08	35.26

Note: The above figures include Princeville.

are sugar and diversified agriculture.

4.2.1 Sugar

By far, the largest users of water are the sugar plantations. The plantations collectively use 355 mgd or 84 percent of the total water use on Kauai. Sugarcane requires large quantities of water, using 6,000 to 10,000 gallons per day per acre depending upon the irrigation system used. The conversion of much of the sugar irrigated acreage from furrow to drip irrigation has saved substantial amounts of water and increased yields through the efficient application of fertilizer.

Sugar is expected to experience a gradual decline in acreage under cultivation due to the increasing cost of production and sugar prices. U.S. sugar support prices are expected to remain unchanged but the costs of labor, materials, equipments, and new facilities are expected to increase with inflation. Sugar companies are actively exploring replacement crops, including macadamia nuts, coffee, tea, cocoa, and citrus. Of these replacement crops, the only land-extensive crop of proven profitability is macadamia nut orchards.

The State Department of Business and Economic Development (DBED) anticipates a decrease in export value statewide for raw sugar from $325 million in 1987 to $230 million by 2010. This amounts to a decline of approximately 30 percent or an average annual decline of 1.5 percent through 2010. Whether sugar will be replaced by other agricultural crops or urbanization will in large part depend upon future sugar prices, the disposition of lease arrangements, and State and County land use policies. The decrease in sugar cultivation may result in a reduced demand for water, given the high consumption rate of sugarcane cultivation.

4.2.2 Diversified Agriculture

Diversified agriculture in the State has done well over the past decade. Kauai has also experienced consistent increases over the past few years. The guava industry has done particularly well, but the papaya has had major setbacks during the same period.

Projections of future water demand for diversified agriculture are difficult to determine except in the aggregate. At this time all increases in diversified agriculture will be assumed to be due to a change in crop from sugar. Therefore, no projections can be made at this time.

4.3 MILITARY WATER DEMAND

The military in Hawaii is expected to continue to maintain a strong presence in the foreseeable future. Water demand for the military is affected principally by the number of active duty personnel and their dependents stationed on Kauai. There are currently about 129 military personnel on Kauai.

The State's expectation per the M-K projections is that the total military population will remain relatively constant in terms of military personnel and civilian employment. No increases in military demand is projected.

4.4 PRIVATE SYSTEMS DEMAND

Private systems water demand is expected to remain relatively constant over the planning period. No major expansions or increases are anticipated, except for the Princeville System. Most of the zoned land is located within the Princeville development area and this is where the expected population growth in the Hanalei area will occur. For this reason the Princeville projections are added into the Hanalei projections.

4.5 SUMMARY OF FUTURE KAUAI WATER DEMAND

Future water demand on Kauai is primarily dependent on the projections of municipal water demand which would be supplied by the Department of Water and private water demand at Princeville. Although presently constituting only about 2 percent of water use on the island, the municipal demand is expected to steadily increase in both the near and long term, to 20.08 mgd by the year 2010. Sugar production have experienced a gradual decline in crop production over the years, and this trend is likely to continue. Although diversified agriculture is expected to increase, the overall acreage in agriculture on Kauai is not expected to increase from present levels.

For the purpose of projecting future water demand it is assumed that the M-K projected decline in sugar exports will result in corresponding changes over to the crops. Therefore, water demand for irrigation is not projected to rise or fall but remain constant, except for 4.8 mgd of water demand for two State agricultural parks.

The military presence on Kauai is expected to remain relatively stable in terms of the number of active military personnel and dependents stationed on the island. Private systems and industrial use are expected to remain stable in usage through the planning period.

Municipal water demand is driven primarily by population increases and associated land use allowances for increased residential and other urban activities. The overall impact on water resources, however, may not be significant depending upon the amount of the source available.

4.6 AREAL IMBALANCES IN FUTURE DEMAND/SUPPLY

The basic directions for growth on Kauai are established by the County's General Plan and implemented by zoning. Table 8 shows future water needs by planning areas, the 20-year or 2010 projections and the maximum demand based on zoning. Tables 9 and 10 present the projected 20-year ground and surface water use, respectively, within a hydrologic unit and Tables 11 and 12 show the projected 20-year ground and surface

TABLE 9

Kauai Water Use and Development Plan
PROJECTED 20-YEAR WATER USE SUMMARY
Ground Water Used in Hydrologic Unit

Hydrologic System		Ground Water Used (MGD)			Ground Sustainable Yield (MGD)
		Municipal /Other	Irrigation	Total	
Koloa	20101	4.94	26.02	30.96	30
Hanamaulu	20102	6.03	1.52	7.55	40
Wailua	20103	0.89	1.00	1.89	60
Anahola	20104	2.91	4.65	7.56	36
Kilauea	20105	0.40	0.00	0.40	17
Kalihiwai	20201	1.27	0.00	1.27	16
Hanalei	20202	1.19	0.00	1.19	35
Wainiha	20203	0.25	0.00	0.25	24
Napali	20204	0.00	0.00	0.00	20
Kekaha	20301	1.04	19.17	20.21	12
Waimea	20302	0.23	0.00	0.23	42
Makaweli	20303	0.33	2.15	2.48	30
Hanapepe	20304	0.12	0.00	0.12	26

Municipal figures show the water used by the Department of Water Supply for Kauai County. Other water use reflects water used by private domestic water systems. Irrigation figures list the water used by agricultural activities. Total use is the sum of the Municipal/Other and Irrigation use.

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Water used in a hydrologic unit describes where water is actually utilized for domestic or irrigation purposes. Water use does not directly impact the sustainable yield of a hydrologic unit as water could be withdrawn and transported from another hydrologic unit.

TABLE 10

Kauai Water Use and Development Plan
PROJECTED 20-YEAR WATER USE SUMMARY
Surface Water Used in Hydrologic Unit

Hydrologic System		Surface Water Used (MGD)			Surface Sustainable Yield (MGD)
		Municipal /Other	Irrigation	Total	
Koloa	20101	0.50	28.52	29.02	21.7
Hanamaulu	20102	0.00	26.08	26.08	34.2
Wailua	20103	0.00	43.61	43.61	147.4
Anahola	20104	0.00	35.91	35.91	30.9
Kilauea	20105	0.00	6.89	6.89	16.8
Kalihiwai	20201	0.00	0.11	0.11	30.3
Hanalei	20202	0.00	13.15	13.15	151.5
Wainiha	20203	53.89	8.29	62.18	252.4
Napali	20204	0.00	0.00	0.00	12.8
Kekaha	20301	0.00	52.53	52.53	2.8
Waimea	20302	0.00	5.78	5.78	43.8
Makaweli	20303	0.00	77.58	77.58	22.6
Hanapepe	20304	0.00	7.02	7.02	43.6

Municipal figures show the water used by the Department of Water Supply for Kauai County. Other water use reflects water used by private domestic water systems. Irrigation figures list the water used by agricultural activities. Total use is the sum of the Municipal/Other and Irrigation use.

Sustainable Yields represent an estimate of the rate of total pumpage which can be continuously drawn from a system without affecting either the quality or quantity of the output. Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water used in a hydrologic unit describes where water is actually utilized for domestic or irrigation purposes. Water use does not directly impact the sustainable yield of a hydrologic unit as water could be withdrawn and transported from another hydrologic unit.

TABLE 11

Kauai Water Use and Development Plan
PROJECTED 20-YEAR WATER USE SUMMARY
Ground Water Withdrawn from Hydrologic Unit

Hydrologic System		Ground Water Withdrawn (MGD) Municipal /Other	Irrigation	Total	Ground Sustainable Yield (MGD)
Koloa	20101	4.94	10.34	15.28	30
Hanamaulu	20102	6.03	1.52	7.55	40
Wailua	20103	0.89	1.00	1.89	60
Anahola	20104	2.91	4.65	7.56	36
Kilauea	20105	0.49	0.00	0.49	17
Kalihiwai	20201	1.46	0.00	1.46	16
Hanalei	20202	0.93	0.00	0.93	35
Wainiha	20203	0.25	0.00	0.25	24
Napali	20204	0.00	0.00	0.00	20
Kekaha	20301	0.49	19.17	19.66	12
Waimea	20302	0.78	0.00	0.78	42
Makaweli	20303	0.33	2.15	2.48	30
Hanapepe	20304	0.12	15.68	15.80	26

Municipal figures show the water withdrawn by the Department of Water Supply for Kauai County. Other water withdrawn reflects water withdrawn by private domestic water systems. Irrigation numbers list the water withdrawn for agricultural activities. Total water withdrawn is the sum of the Municipal/Other and Irrigation figures.

Sustainable Yields represent an estimate of the rate of total pumpage which can be continuously drawn from a system without affecting either the quality or quantity of the output. Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water withdrawn from a hydrologic unit describes the water taken from a hydrologic unit by well pumping, tunnels, or stream diversions for domestic or agricultural uses.

TABLE 12

Kauai Water Use and Development Plan
PROJECTED 20-YEAR WATER USE SUMMARY
Surface Water Withdrawn from Hydrologic Unit

Hydrologic System		Surface Water Withdrawn (MGD) Municipal /Other	Irrigation	Total	Surface Sustainable Yield (MGD)
Koloa	20101	0.50	12.03	12.53	21.7
Hanamaulu	20102	0.00	7.22	7.22	34.2
Wailua	20103	0.00	60.52	60.52	147.4
Anahola	20104	0.00	25.63	25.63	30.9
Kilauea	20105	0.00	6.89	6.89	16.8
Kalihiwai	20201	0.00	0.11	0.11	30.3
Hanalei	20202	0.00	30.61	30.61	151.5
Wainiha	20203	53.89	8.29	62.18	252.4
Napali	20204	0.00	0.00	0.00	12.8
Kekaha	20301	0.00	0.53	0.53	2.8
Waimea	20302	0.00	57.78	57.78	43.8
Makaweli	20303	0.00	51.58	51.58	22.6
Hanapepe	20304	0.00	44.28	44.28	43.6

Municipal figures show the water withdrawn by the Department of Water Supply for Kauai County. Other water withdrawn reflects water withdrawn by private domestic water systems. Irrigation numbers list the water withdrawn for agricultural activities. Total water withdrawn is the sum of the Municipal/Other and Irrigation figures.

Sustainable Yields represent an estimate of the rate of total pumpage which can be continuously drawn from a system without affecting either the quality or quantity of the output. Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water withdrawn from a hydrologic unit describes the water taken from a hydrologic unit by well pumping, tunnels, or stream diversions for domestic or agricultural uses.

water withdrawn, respectively, from a hydrologic unit. Figure 6 shows the projected 20-year demand by municipal system and Figure 8 shows the projected long range demand by municipal system based on zoning. Figure 7 shows the projected 20-year water demand by hydrologic unit and Figure 9 shows the long range demand hydrologic systems. Tables 13 and 14 present the projected long range ground and surface water use, respectively, within a hydrologic unit and Tables 15 and 16 show the projected long-range ground and surface water withdrawn, respectively, from a hydrologic unit. The long range water use is determined by calculating the total water demand at full development of all the General Plan lands on Kauai. This is expected to occur after the year 2030 at present growth rates.

The areas requiring the greatest amounts of water by the year 2010 are Kawaihau, Lihue and Koloa-Poipu. Kawaihau will need 1.16 mgd additional water supply to meet the projected population. Lihue, Koloa-Poipu and Kalaheo-Lawai will have additional needs of 3.47 mgd, 1.83 mgd, and 0.69, respectively. All other areas will need additionally about 0.5 mgd or less by the year 2010. The Hanalei-Kalihiwai area which includes Princeville will require another 1.53 mgd.

The sustainable yield figures show that groundwater is available in the hydrologic units to meet the water demand beyond the year 2010, except for Kekaha. While the hydrologic units have the available sustainable yields to meet the projected demands, the DOW must develop the wells to extract the water from the ground for use. Potential sources have been identified by the present Water Master plan and additional sources have been identified since then. Additional well testing and exploration will be required to meet the projected 2010 and long range demands. Alternative sources, including the expansion of surface water treatment facilities, will also have to be studied for the long range plan.

The Kekaha area is already importing some its potable water from the Waimea hydrologic unit to the Kekaha unit. The Lihue area or Hanamaulu Hydrologic unit can now import water from the Wailua-Kapaa or the Wailua hydrologic unit and portions of the Anahola hydrologic unit. This will be required to meet projected peak flow demands but there is adequate capacity to meet the average daily demands within the hydrologic unit. The koloa-Poipu water system should be connected to the Lawai-Kalaheo system to increase the reliability of both systems.

The areal imbalances created by the importation of surface water for irrigation from one hydrologic unit to another is expected to persist as it exists today. The sugar companies can divert water from streams in other hydrologic units to this fields by extensive systems of ditches and tunnels. The Kekaha Sugar Company and Lihue Plantation Company move large amounts of surface water from one hydrologic unit to another. Plans to convert some cane fields to residential or other urban activities will reduce irrigation requirements, reducing some of the areal imbalances. The conversion will also reduce groundwater requirements for irrigation as in the Koloa-Poipu and Kalaheo-Lawai areas.

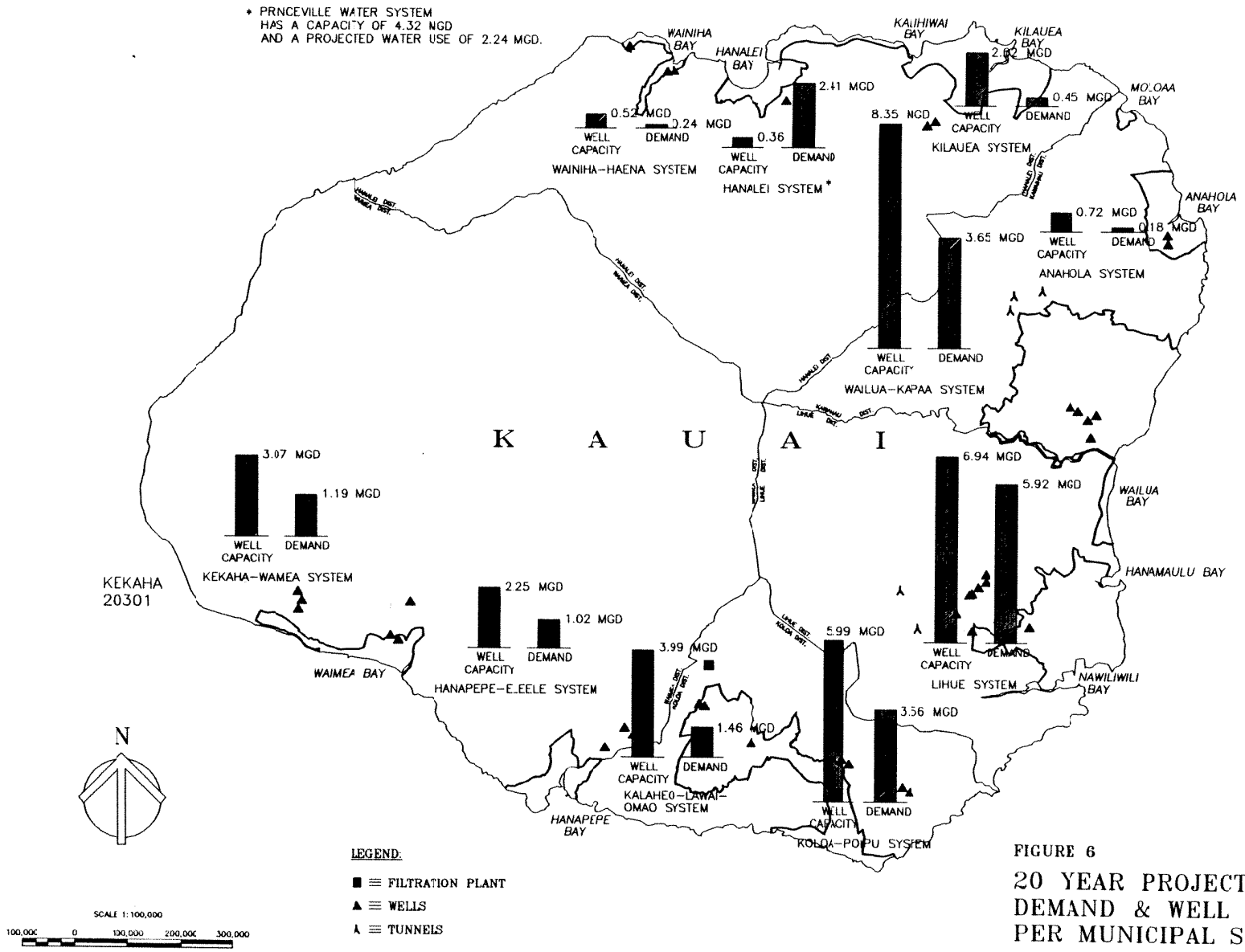


FIGURE 6

20 YEAR PROJECTED WATER DEMAND & WELL CAPACITIES PER MUNICIPAL SYSTEM

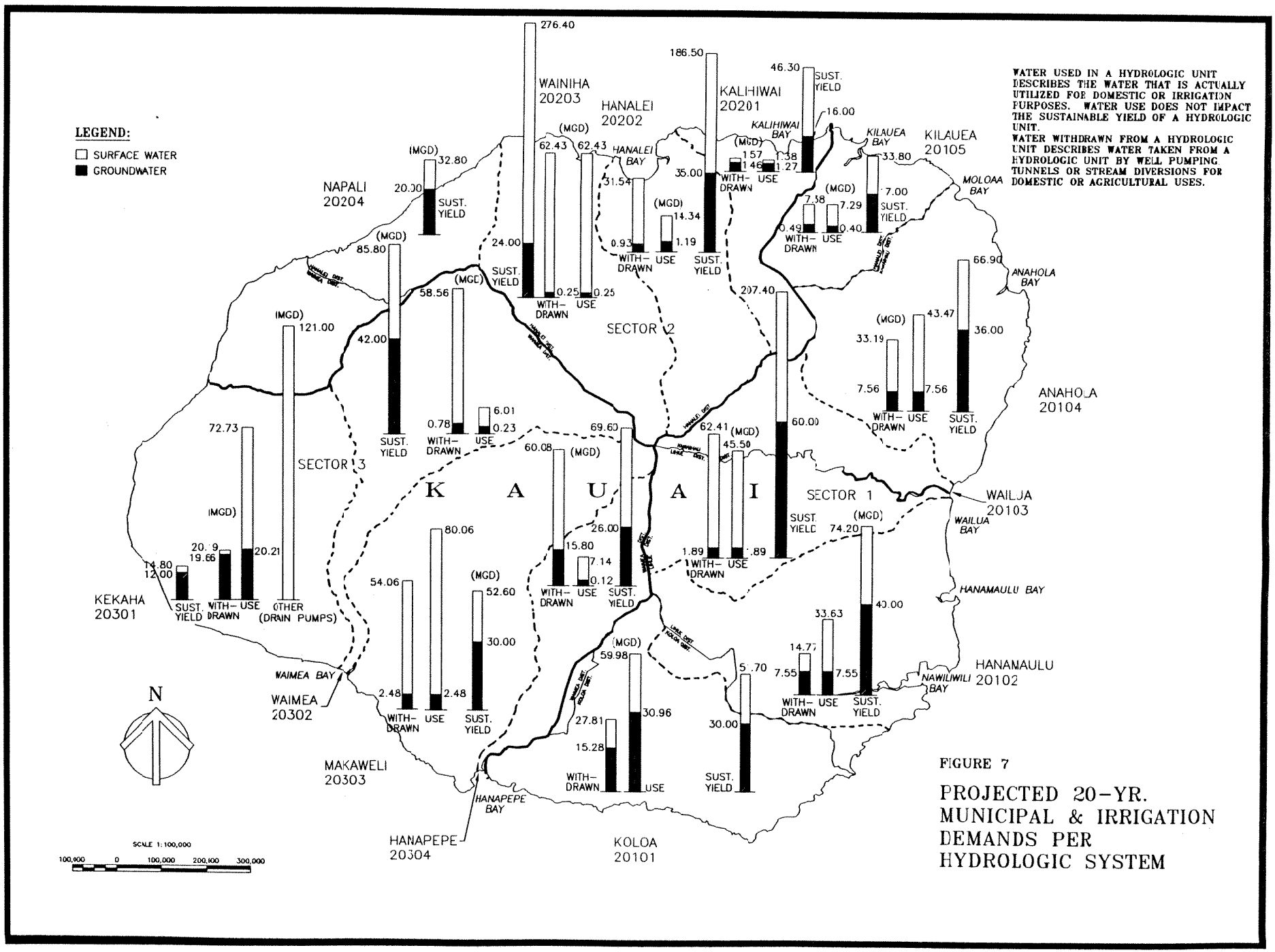


FIGURE 7

PROJECTED 20-YR. MUNICIPAL & IRRIGATION DEMANDS PER HYDROLOGIC SYSTEM

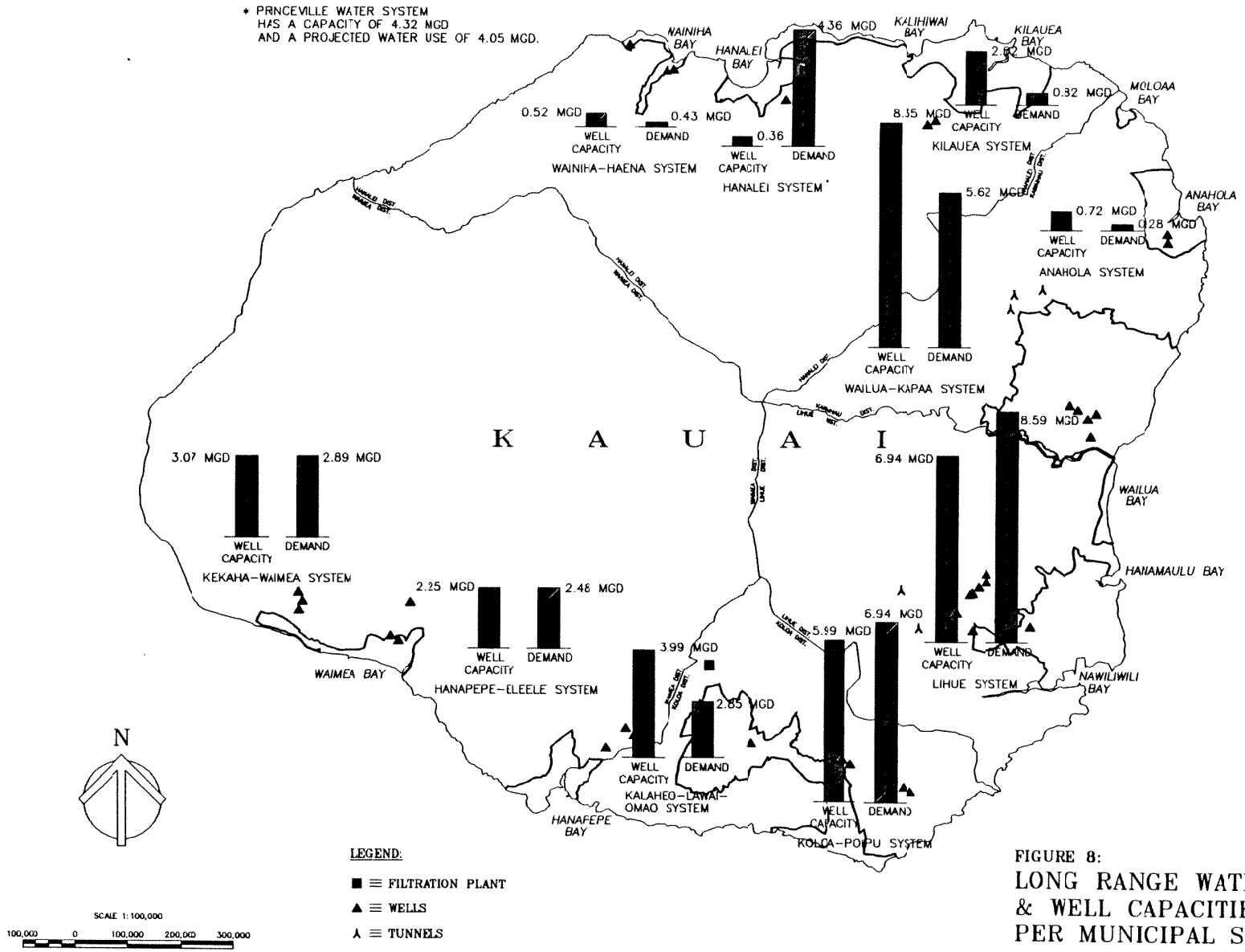
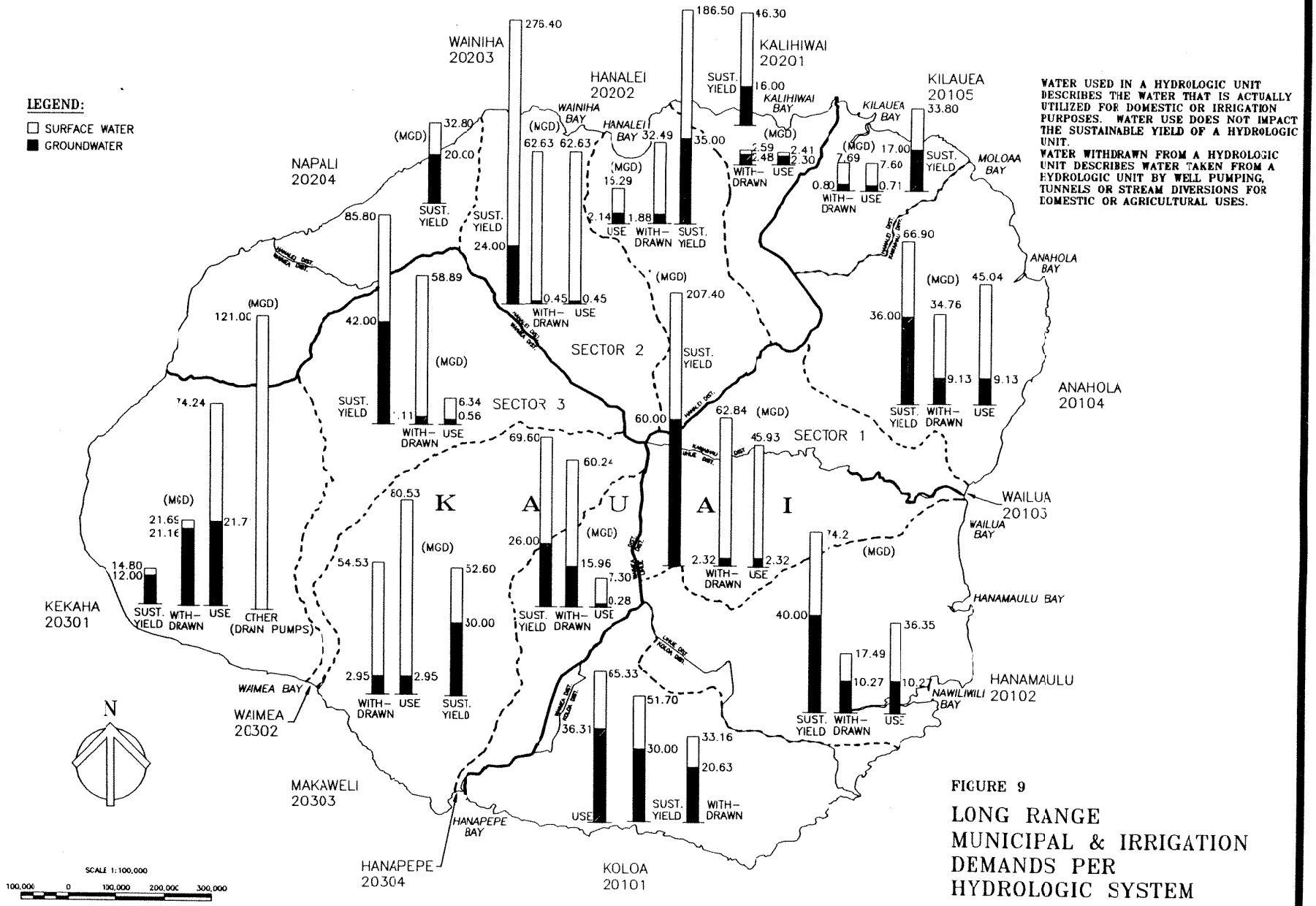


FIGURE 8:
LONG RANGE WATER DEMAND
& WELL CAPACITIES
PER MUNICIPAL SYSTEM



WATER USED IN A HYDROLOGIC UNIT DESCRIBES THE WATER THAT IS ACTUALLY UTILIZED FOR DOMESTIC OR IRRIGATION PURPOSES. WATER USE DOES NOT IMPACT THE SUSTAINABLE YIELD OF A HYDROLOGIC UNIT.
WATER WITHDRAWN FROM A HYDROLOGIC UNIT DESCRIBES WATER TAKEN FROM A HYDROLOGIC UNIT BY WELL PUMPING, TUNNELS OR STREAM DIVERSIONS FOR DOMESTIC OR AGRICULTURAL USES.

FIGURE 9

LONG RANGE MUNICIPAL & IRRIGATION DEMANDS PER HYDROLOGIC SYSTEM

TABLE 13

Kauai Water Use and Development Plan
LONG RANGE WATER USE SUMMARY
Ground Water Used in Hydrologic Unit

Hydrologic System		Ground Water Used (MGD)			Ground Sustainable Yield (MGD)
		Municipal /Other	Irrigation	Total	
Koloa	20101	10.29	26.02	36.31	30
Hanamaulu	20102	8.75	1.52	10.27	40
Wailua	20103	1.32	1.00	2.32	60
Anahola	20104	4.48	4.65	9.13	36
Kilauea	20105	0.71	0.00	0.71	17
Kalihiwai	20201	2.30	0.00	2.30	16
Hanalei	20202	2.14	0.00	2.14	35
Wainiha	20203	0.45	0.00	0.45	24
Napali	20204	0.00	0.00	0.00	20
Kekaha	20301	2.54	19.17	21.71	12
Waimea	20302	0.56	0.00	0.56	42
Makaweli	20303	0.80	2.15	2.95	30
Hanapepe	20304	0.28	0.00	0.28	26

Municipal figures show the water used by the Department of Water Supply for Kauai County. Other water use reflects water used by private domestic water systems. Irrigation figures list the water used by agricultural activities. Total use is the sum of the Municipal/Other and Irrigation use.

Sustainable Yields represent an estimate of the rate of total pumpage which can be continuously drawn from a system without affecting either the quality or quantity of the output. Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water used in a hydrologic unit describes where water is actually utilized for domestic or irrigation purposes. Water use does not directly impact the sustainable yield of a hydrologic unit as water could be withdrawn and transported from another hydrologic unit.

TABLE 14

Kauai Water Use and Development Plan
LONG RANGE WATER USE SUMMARY
Surface Water Used in Hydrologic Unit

Hydrologic System		Surface Water Used (MGD)			Surface Sustainable Yield (MGD)
		Municipal /Other	Irrigation	Total	
Koloa	20101	0.50	28.52	29.02	21.7
Hanamaulu	20102	0.00	26.08	26.08	34.2
Wailua	20103	0.00	43.61	43.61	147.4
Anahola	20104	0.00	35.91	35.91	30.9
Kilauea	20105	0.00	6.89	6.89	16.8
Kalihiwai	20201	0.00	0.11	0.11	30.3
Hanalei	20202	0.00	13.15	13.15	151.5
Wainiha	20203	53.89	8.29	62.18	252.4
Napali	20204	0.00	0.00	0.00	12.8
Kekaha	20301	0.00	52.53	52.53	2.8
Waimea	20302	0.00	5.78	5.78	43.8
Makaweli	20303	0.00	77.58	77.58	22.6
Hanapepe	20304	0.00	7.02	7.02	43.6

Municipal figures show the water used by the Department of Water Supply for Kauai County. Other water use reflects water used by private domestic water systems. Irrigation figures list the water used by agricultural activities. Total use is the sum of the Municipal/Other and Irrigation use.

Sustainable Yields represent an estimate of the rate of total pumpage which can be continuously drawn from a system without affecting either the quality or quantity of the output. Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water used in a hydrologic unit describes where water is actually utilized for domestic or irrigation purposes. Water use does not directly impact the sustainable yield of a hydrologic unit as water could be withdrawn and transported from another hydrologic unit.

TABLE 15

Kauai Water Use and Development Plan
LONG RANGE WATER USE SUMMARY
Ground Water Withdrawn from Hydrologic Unit

Hydrologic System		Ground Water Withdrawn (MGD) Municipal /Other	Irrigation	Total	Ground Sustainable Yield (MGD)
Koloa	20101	10.29	10.34	20.63	30
Hanamaulu	20102	8.75	1.52	10.27	40
Wailua	20103	1.32	1.00	2.32	60
Anahola	20104	4.48	4.65	9.13	36
Kilauea	20105	0.80	0.00	0.80	17
Kalihiwai	20201	2.48	0.00	2.48	16
Hanalei	20202	1.88	0.00	1.88	35
Wainiha	20203	0.45	0.00	0.45	24
Napali	20204	0.00	0.00	0.00	20
Kekaha	20301	1.99	19.17	21.16	12
Waimea	20302	1.11	0.00	1.11	42
Makaweli	20303	0.80	2.15	2.95	30
Hanapepe	20304	0.28	15.68	15.96	26

Municipal figures show the water withdrawn by the Department of Water Supply for Kauai County. Other water withdrawn reflects water withdrawn by private domestic water systems. Irrigation numbers list the water withdrawn for agricultural activities. Total water withdrawn is the sum of the Municipal/Other and Irrigation figures.

Sustainable Yields represent an estimate of the rate of total pumpage which can be continuously drawn from a system without affecting either the quality or quantity of the output. Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water withdrawn from a hydrologic unit describes the water taken from a hydrologic unit by well pumping, tunnels, or stream diversions for domestic or agricultural uses.

TABLE 16

Kauai Water Use and Development Plan
LONG RANGE WATER USE SUMMARY
Surface Water Withdrawn from Hydrologic Unit

Hydrologic System		Surface Water Withdrawn (MGD) Municipal /Other	Irrigation	Total	Surface Sustainable Yield (MGD)
Koloa	20101	0.50	12.03	12.53	21.7
Hanamaulu	20102	0.00	7.22	7.22	34.2
Wailua	20103	0.00	60.52	60.52	147.4
Anahola	20104	0.00	25.63	25.63	30.9
Kilauea	20105	0.00	6.89	6.89	16.8
Kalihiwai	20201	0.00	0.11	0.11	30.3
Hanalei	20202	0.00	30.61	30.61	151.5
Wainiha	20203	53.89	8.29	62.18	252.4
Napali	20204	0.00	0.00	0.00	12.8
Kekaha	20301	0.00	0.53	0.53	2.8
Waimea	20302	0.00	57.78	57.78	43.8
Makaweli	20303	0.00	51.58	51.58	22.6
Hanapepe	20304	0.00	44.28	44.28	43.6

Municipal figures show the water withdrawn by the Department of Water Supply for Kauai County. Other water withdrawn reflects water withdrawn by private domestic water systems. Irrigation numbers list the water withdrawn for agricultural activities. Total water withdrawn is the sum of the Municipal/Other and Irrigation figures.

Sustainable Yields represent an estimate of the rate of total pumpage which can be continuously drawn from a system without affecting either the quality or quantity of the output. Sustainable Yields are pre-development estimates and are provided only as a general guide. The estimates for surface water are very approximate. Further study is indicated before more definitive conclusions can be drawn for planning purposes.

Water withdrawn from a hydrologic unit describes the water taken from a hydrologic unit by well pumping, tunnels, or stream diversions for domestic or agricultural uses.

SECTION 5

PLAN IMPLEMENTATION

5.1 PROPOSED WATER DEVELOPMENTS

This section describes proposed water developments to be undertaken by government agencies and the private sector. In the County of Kauai, the coordination of public facilities with land use has been implemented through the General Plan process.

5.1.1 Municipal Water Development Plans

Table 17 lists by hydrologic unit the DOW projects that will be required to meet the water demand for the next 20 years. Figure 10 shows the location of these proposed improvements. Proposed projects over the next 20-year timeframe will involve the expenditure of $94,000,000 in capital improvements for source production, storage, transmission and support facilities. Cost estimates are developed from the Oahu Board of Water Supply 6 - Year Capital Improvement Program cost estimates for well development and reservoir construction. Actual costs may vary from these estimates as more details on the proposed water source and storage developments are prepared.

5.1.2 Agricultural, Private, and Military Plans

A. Agricultural Plans: The sugar plantations have adequate water supply for their irrigation requirements and have no plans or need for additional water development projects. Ongoing conversion from furrow to drip irrigation is expected to continue to improve sugar yields and free water for use on other fields. The change over of crops may also reduce the water required for irrigation. The State of Hawaii plans to develop two new agricultural parks which will require 4.8 mgd of groundwater from the Anahola and Wailua hydrologic units.

B. Private Sector Plans: The primary development will be the upgrade to the Princeville Water System. A new well and reservoir are planned to support their Phase 2 developments.

C. Military Plans: No new water sources are expected to be developed by any of the military installations.

5.1.3 State Water Development Plans

State water development projects identified by the State Project Plan are listed in the appendix. The projects include Agricultural park irrigation systems and housing

TABLE 17

Kauai Water Use and Development Plan
PROPOSED WATER DEVELOPMENTS FOR KAUAI
DOW DEVELOPMENTS

	System	Type of Improvement	Capacity	Cost
Kekaha-Waimea	301	1 Wells	600 gpm	$2,242,080
		2 Reservoir	1 mg	$3,376,000
	302	3 Exploratory Wells	n.a.	$360,000
Hanapepe-Eleele	304	1 Well	700 gpm	$2,615,760
		2 Reservoir	1 mg	$3,376,000
		13000 Lineal Feet of Pipe	12 in	$975,000
Kalaheo-Lawai	101	1 Well	700 gpm	$2,615,760
		3 Reservoir	1 mg	$5,064,000
Koloa-Poipu	101	2 Well	800 gpm	$5,978,880
		1 Well	1200 gpm	$4,484,160
		7 Reservoir	1 mg	$11,816,000
		12600 Lineal Feet of Pipe	12 in	$945,000
Lihue	102	3 Wells	200 gpm	$2,242,080
		2 Well	700 gpm	$5,231,520
		5 Reservoir	1 mg	$8,440,000
		18500 Lineal Feet of Pipe	12 in	$1,387,500
Wailua-Kapaa	104	1 Well	1000 gpm	$3,736,800
		3 Well	700 gpm	$7,847,280
		2 Well	600 gpm	$4,484,160
		7 Reservoir	1 mg	$11,816,000
		12000 Lineal Feet of Pipe	12 in	$900,000
Kilauea	105	1 Well	700 gpm	$2,615,760
		1 Reservoir	0.5 mg	$844,000
Hanalei	202	1 Well	250 gpm	$934,200
Princeville	201	1 Well	1500 gpm	n.a.
		1 Reservoir	1.5 mg	n.a.
TOTAL				$94,327,940

Unit prices developed from Oahu BWS C.I.P.

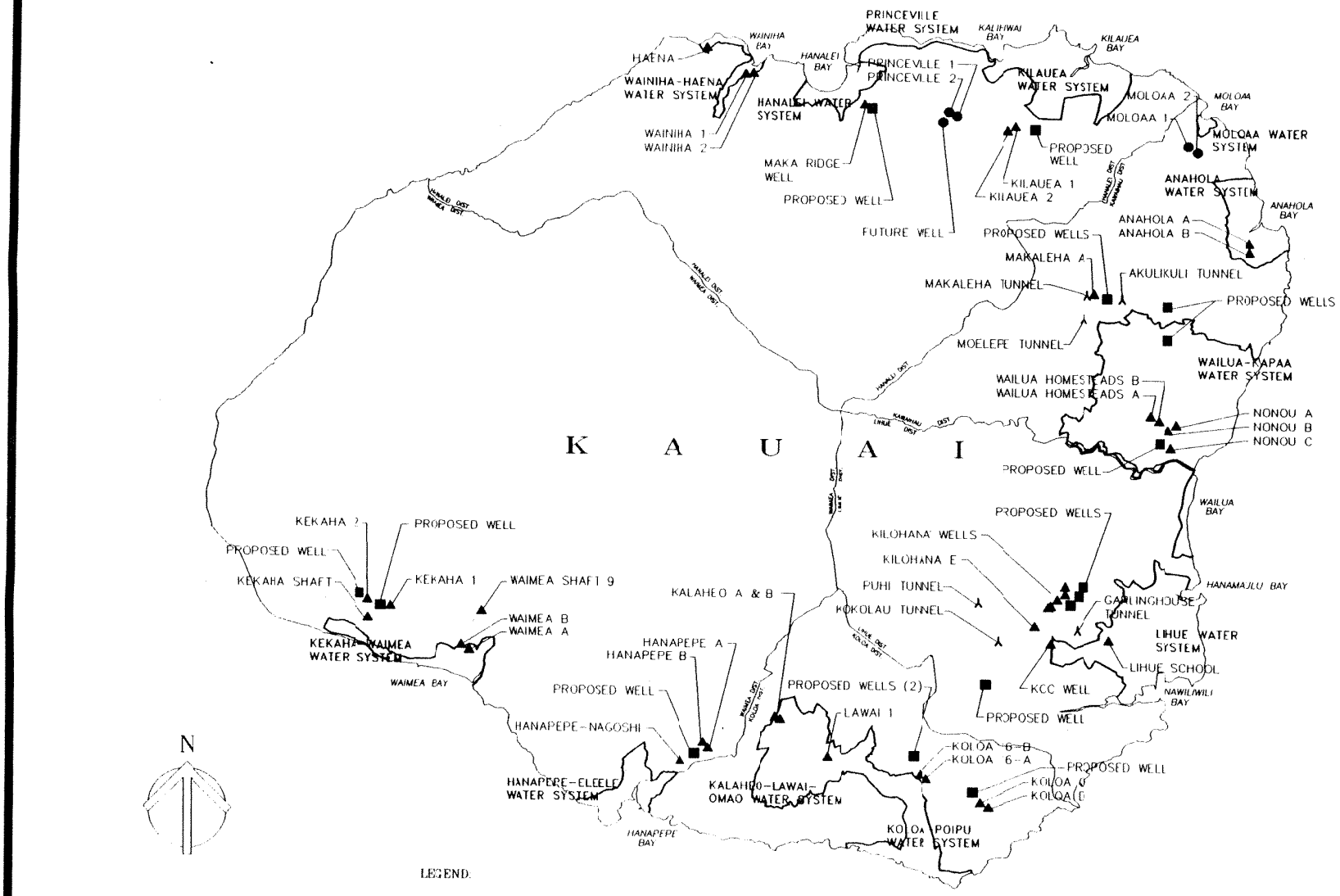


FIGURE 10:
MUNICIPAL SYSTEMS & GROUNDWATER SOURCES

projects. The total water demand for these projects is 8.9 mgd. The 4.8 mgd water demand for the agricultural parks is included above. The remaining projected water demand is included in the municipal water system projections.

5.2 ALTERNATIVE STRATEGIES FOR MEETING FUTURE DEMAND

5.2.1 Greater Use of Non-Potable Sources

The use of non-potable water for agricultural and industrial purposes indirectly enhances potable water supplies for municipal use. This will not be required for Kauai as long as over pumping does not occur in Kekaha and Koloa.

5.2.2 Reuse of Wastewater Effluent

Results of the recent test project at the Honouliuli Wastewater Treatment Plant (WWTP) in Ewa support the potential benefits of wastewater effluent reuse as a source for replenishing non-potable water and maintaining low salinity caprock water. The project, conducted by the University of Hawaii Water Resources Center (WRRC) in conjunction with DLNR, flooded six half-acre plots adjacent to the WWTP with primary-treated effluent once a day. The process produced 68,000 gpd of recharge water per acre, or 14.6 acres per 1 mgd. On sugarcane, recharge was greater but was accompanied by a loss in crop quality due to a failure in the drip-irrigation system which alternately watered the crop. This system will become effective as the flows to Kauai's WWTP increases.

5.2.3 Desalinization

The high salinity water can also be transformed by desalting plants to create potable supplies. By the mid-1990's a $5.7 million desalting plant built near Campbell Industrial Park is expected to produce 1 mgd for household use, with a potential production capacity of 10 mgd. This high technology facility will rely on either reverse osmosis or electrodialysis, the two most commercially proven methods. Both methods can produce purified water with only 25 percent of the saline content of tap water.

With respect to cost, the proposed plant in Ewa should be competitive with the current Oahu BWS rates. With Oahu BWS rates expected to increase, purified water done at $1.50 to $3.00 per 1,000 gallons is not unreasonable. It should be noted that the plant will not be designed to desalinize seawater.

5.2.4 Conservation Measures

The Department of Water can implement extensive water conservation programs similar to the programs on Oahu. These programs fall into two major categories: Water System Conservation and Consumer Conservation.

Water system conservation involves efforts by the DOW to account for all the water in their transmission and distribution systems. Even water used for firefighting and street and sewer flushing must be measured through various means. This careful monitoring will enable the DOW to pinpoint discrepancies within the system and to institute conservation measures where required.

Furthermore, a leak detection program will minimize losses that inevitably occur in such a large system. Under certain circumstances, leaks in piping may go undetected for a long time and cause large losses. The leak detection program can be a preventive program too, sometimes revealing a need for pipe replacements.

While the DOW has the ability to regulate its own systems, regulating consumer consumption is more difficult. Because a reduction in per capita consumption can partially offset population increases, long-range public information and awareness campaigns will help to educate the public.

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APPENDIX

TABLE OF CONTENTS

TABLE A-1

Kauai General Plan - Population Distributions, Kukuiula Included

District	PF	RR	R	UR	UMU	A
		Land Area (Acres)				
Waimea	2212	0	0	1839	165	26268
Koloa	92	935	730	2934	0	15368
Lihue	1040	0	329	506	2584	5068
Kawaihau	455	938	228	1864	613	19847
Hanalei	0	230	1577	376	0	11773
Totals	3799	2103	2864	7519	3362	78324

District	PF	RR	R	UR	UMU	Ratio Res.	Ratio Vis.	
		Housing/Visitor Units						
Waimea	2212	0	0	9197	495	0.183	0.044	
Koloa	92	1871	7303	14668	0	0.321	0.234	
Lihue	1040	0	6571	2532	7752	0.194	0.197	
Kawaihau	455	1877	4563	9319	1838	0.255	0.155	
Hanalei	0	459	15768	1880	0	0.046	0.369	
Totals	3799	4207	34206	37596	10085	42352	43742	
Equiv. Pop.	0	13672.	62938.	122186	32776.98	137643	80485	0.5847
Maximum 2010 Population: DBED						86900	37600	0.4327

Assumptions:

RR - Rural Residential	2	Units/Acre Average
UR - Urban Residential	5	Units/Acre Average
		80% Res. & 20% Vis.
R - Resort - Wailua	20	Units/Acre Average
Lihue	20	Units/Acre Average
Princeville	10	Units/Acre Average
Koloa	10	Units/Acre Average
UMU - Urbam Mixed Use	3	Units/Acre Average
		80% Res. & 20% Vis.
Residential Units	3.25	Capita/Unit
Resort Units	2.3	Capita/Unit @ 80.0% Occupancy

District	Ratio Res.	Ratio Vis.	Res. Dist.	Vis. Dist.	Totals 2010	Totals Ultimate
Waimea	0.183	0.044	15909	1666	17576	28766
Koloa	0.321	0.234	27916	8799	36715	63052
Lihue	0.194	0.197	16882	7417	24299	42616
Kawaihau	0.255	0.155	22165	5840	28005	47609
Hanalei	0.046	0.369	4027	13878	17905	36085
Totals 2010 Population			86900	37600	124500	
Totals 2041 Population			137643	80485	218128	

Revised Long-Range Economic and Population Projections to 2010, State of Hawaii (Series M-K). 2041 Population based on 2.5% growth.

TABLE A-2

PROJECTED WATER USE BY WATER DISTRICT

1988
total de facto pop. = 65,300

zone	district	resident pop.	percent visitor	visitor pop.	total pop.	water use (MGD)	rate of use (use/cap)
1	Waimea	8,885	1.4	228	9,113	1.70	186.6
2	Koloa	11,485	27.9	4,534	16,019	2.49	155.4
3	Lihue	10,190	23.7	3,851	14,041	2.83	201.5
4	Kawaihau	13,340	29.2	4,745	18,085	2.24	123.9
5	Hanalei	5,150	17.8	2,893	8,043	1.25	155.4
		49,050					

total visitor pop. = 16,250

		2010		Long Range	
zone	district	total pop.	use (MGD)	total pop.	use (MGD)
1	Waimea	11,827	2.21	28,766	5.37
2	Koloa	32,360	5.03	63,052	9.80
3	Lihue	29,402	5.93	42,616	8.59
4	Kawaihau	30,909	3.83	47,609	5.90
5	Hanalei	20,003	3.11	36,085	5.61
		124,501	20.10	218,128	35.26

TABLE A-3

PROJECT TITLE: KAUAI WATER USE AND DEVELOPMENT PLAN JOB NO.: 1-15439-0E file: MELFPCPU.WK1
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: PROJECTED 20 YEAR WATER USE BY MUNICIPAL SYSTEM DATE: 31-JAN-90 REV: 07-MAY-90
DESCRIPTION: This spreadsheet tabulates the current population by municipal water system. This is then used to redistribute the projected 20-year water use by water district into water use by municipal system.

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P
	KALAHEO-LAWAI SYSTEM													
101	KALAHEO	4.4	128.6	374.5	54.9	3.0	0.0	2.6	0.0	0.0	0.0	15.9	1.5	0.0
101	LAWAI	0.0	14.9	161.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
101	OMAO	0.0	243.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	4.4	386.7	536.2	54.9	3.0	0.0	2.6	0.0	0.0	0.0	15.9	1.5	0.0
	NUMBER OF UNITS:	4.4	773.4	2145	329.46	30	0	52	0	0	0	63.6	9	0
	TOTAL NUMBER OF UNITS:				3252			82		0				73
	TOTAL POPULATIONS:				10569		91 <	124		0				236
	KOLOA-POIPU SYSTEM													
101	LAWAI-KUKUIULA	0.0	14.9	11.6	123.0	44.0	0.0	41.2	0.0	0.0	0.0	0.0	0.0	0.0
101	KOLOA	11.1	6.7	66.0	202.7	16.4	0.0	7.4	0.0	0.0	0.0	21.5	1.3	0.0
101	POIPU	0.0	0.0	85.6	35.5	160.1	0.0	71.1	30.2	53.9	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	11.1	21.6	163.2	361.2	220.5	0.0	119.7	30.2	53.9	0.0	21.5	1.3	0.0
	NUMBER OF UNITS:	11.1	43.2	653	2167.3	2205	0	2394	604	2156	0	94	7.8	0
	TOTAL NUMBER OF UNITS:				2874			4599		2760				102
	TOTAL POPULATIONS:				9342		5082 <	6981		5078				331
	LIHUE SYSTEM													
102	HANAMAULU	0.0	0.0	17.2	136.9	15.3	0.0	2.1	0.0	0.0	0.0	0.0	6.0	0.0
102	LIHUE-KAPAIA	0.0	0.0	193.6	136.7	8.2	0.0	48.6	0.0	0.0	57.2	15.0	0.0	0.0
102	NAWILIWILI	0.0	1.8	65.1	33.0	0.0	0.0	4.0	0.0	92.0	38.0	0.0	0.0	0.0
102	PUHI	0.0	0.0	0.0	52.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	0.0	1.8	275.9	358.6	27.0	0.0	54.7	0.0	92.0	135.2	15.0	6.0	0.0
	NUMBER OF UNITS:	0	3.6	1104	2151.6	270	0	1094	0	3680	135.2	60	36	0
	TOTAL NUMBER OF UNITS:				3259			1364		3680				201
	TOTAL POPULATIONS:				10591		1507 <	2071		6771				654

	TOTALS	MUNICIPAL WATER USE (MGD)
	3407 UNITS	1.46
	11020 PEOPLE	
	10335 UNITS	3.56
	26814 PEOPLE	
	8504 UNITS	5.92
	21594 PEOPLE	

KOLOA WATER DISTRICT

POPULATION:	32360
USE (MGD):	5.03
MUNIC. RATE OF USE:	132.9

LIHUE WATER DISTRICT

POPULATION:	29402
USE (MGD):	5.92

PROJECT TITLE: KAUAI WATER USE AND DEVELOPMENT PLAN JOB NO.: 1-15409-0E file: MELFPCPU.WK1
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: PROJECTED 20 YEAR WATER USE BY MUNICIPAL SYSTEM DATE: 31-JAN-90 REV: 07-MAY-90
DESCRIPTION: This spreadsheet tabulates the current population by municipal water system. This is then used to redistribute the projected 20-year water use by water district into water use by municipal system.

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P
	WAILUA-KAPAA SYSTEM													
102	WAILUA-WAIPOULI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0
103	WAILUA	0.0	0.0	0.0	65.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
103	WAILUA HOMESTEADS	0.0	323.0	233.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
103	WAILUA-WAIPOULI	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	10.1	0.0	0.0	0.0	0.0
104	WAILUA-WAIPOULI	0.0	0.0	0.0	45.2	8.7	0.0	38.8	0.0	86.4	0.0	0.0	0.0	4.7
104	WAILUA	0.0	0.0	0.0	111.6	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.0
104	KAPAA	0.0	0.0	163.8	68.5	20.6	0.0	6.9	0.0	0.0	147.8	14.1	0.0	0.0
104	KAPAA HOMESTEADS	0.0	0.0	105.5	219.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	0.0	323.0	507.0	511.6	29.3	0.0	45.7	0.0	104.0	147.8	21.6	0.0	4.7
	NUMBER OF UNITS:	0	646	2028	3069.6	293	0	913.4	0	4160	147.8	86.4	0	47
	TOTAL NUMBER OF UNITS:				5744			1206		4160				281
	TOTAL POPULATIONS:				18367		1333 <	1831		7654				914
	ANAHOLA SYSTEM													
104	ANAHOLA	0.0	63.9	83.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0
	TOTAL AREA:(AC.)	0.0	63.9	83.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0
	NUMBER OF UNITS:	0	27.76	333	0	0	0	0	0	0	0	9.44	0	0
	TOTAL NUMBER OF UNITS:				460			0		0				9
	TOTAL POPULATIONS:				1496		0 <	0		0				31
	KILAUEA SYSTEM													
105	KILAUEA	0.0	0.0	47.6	77.4	0.0	0.0	0.0	0.0	0.0	0.0	6.4	0.0	0.0
201	KILAUEA	0.0	0.0	2.4	21.8	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0
	TOTAL AREA:(AC.)	0.0	0.0	50.0	99.2	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0
	NUMBER OF UNITS:	0	0	200	595.2	0	0	0	0	0	0	36	0	0
	TOTAL NUMBER OF UNITS:				795			0		0				36
	TOTAL POPULATIONS:				2584		0 <	0		0				117

11391 UNITS 3.65
30399 PEOPLE

KAWAIHAU WATER DISTRICT

POPULATION: 30909
USE (MGD): 3.83
MUNIC. RATE OF USE: 120.0

470 UNITS 0.18
1527 PEOPLE

331 UNITS 0.45
2701 PEOPLE

PROJECT TITLE: KAUAI WATER USE AND DEVELOPMENT PLAN JOB NO.: 1-15409-0E file: MELFPOPU.WK1
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: PROJECTED 20 YEAR WATER USE BY MUNICIPAL SYSTEM DATE: 31-JAN-90 REV: 07-MAY-90
DESCRIPTION: This spreadsheet tabulates the current population by municipal water system. This is then used to redistribute the projected 20-year water use by water district into water use by municipal system.

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P
	HANALEI-PRINCEVILLE SYSTEM													
201	PRINCEVILLE	0.0	0.0	151.0	0.0	83.0	43.7	0.0	0.0	20.5	0.0	0.0	0.0	0.0
202	PRINCEVILLE	0.0	0.0	69.0	0.0	29.8	16.6	6.2	59.2	16.5	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	0.0	0.0	220.0	0.0	112.8	60.3	6.2	59.2	37.0	0.0	0.0	0.0	0.0
	NUMBER OF UNITS:	0	0	880	0	1128	904.5	124	1184	1480	0	0	0	0
	TOTAL NUMBER OF UNITS:				880			2157		2664				0
	TOTAL POPULATIONS:				2860		2383 <	3274		4902				0
202	HANALEI TOWN	2.5	0.0	78.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	2.5	0.0	78.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	NUMBER OF UNITS:	2.5	0	314	0	0	0	0	0	0	0	0	0	0
	TOTAL NUMBER OF UNITS:				317			0		0				0
	TOTAL POPULATIONS:				1030		0 <	0		0				0
	WAINIHA-HAENA SYSTEM													
203	WAINIHA	66.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
203	WAINIHA-HAENA	0.0	15.3	77.9	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	66.9	15.3	77.9	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0
	NUMBER OF UNITS:	66.9	30.6	312	0	0	0	0	58	0	0	0	0	0
	TOTAL NUMBER OF UNITS:				409			0		58				0
	TOTAL POPULATIONS:				1330		0 <	0		107				0

HANALEI WATER DISTRICT

POPULATION:	20003	
USE (MGD):	3.11	
MUNIC. RATE OF USE:	167.2	
	5701 UNITS	2.24
	13418 PEOPLE	
	317 UNITS	0.17
	1030 PEOPLE	
	467 UNITS	0.24
	1436 PEOPLE	

PROJECT TITLE: KAUAI WATER USE AND DEVELOPMENT PLAN JOB NO.: 1-15409-0E file: MELFPOPU.WK1
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: PROJECTED 20 YEAR WATER USE BY MUNICIPAL SYSTEM DATE: 31-JAN-90 REV: 07-MAY-90
DESCRIPTION: This spreadsheet tabulates the current population by municipal water system. This is then used to redistribute the projected 20-year water use by water district into water use by municipal system.

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P
	KEKAHA-WAIMEA SYSTEM													
301	KEKAHA	0.0	0.0	94.8	136.7	20.8	0.0	0.0	0.0	0.0	0.0	0.0	7.2	1.5
301	WAIMEA	0.0	0.0	40.1	1.2	0.0	0.0	0.0	0.0	0.0	40.8	0.0	0.0	0.0
302	WAIMEA	0.0	71.7	64.1	0.0	7.5	0.0	0.0	0.0	0.0	17.1	0.0	0.0	0.0
303	WAIMEA	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	0.0	71.7	208.1	137.9	28.3	0.0	0.0	0.0	0.0	57.9	0.0	7.2	1.5
	NUMBER OF UNITS:	0	143.4	832	827.64	282.7	0	0	0	0	57.9	0	43.2	15
	TOTAL NUMBER OF UNITS:				1303			283		0				116
	TOTAL POPULATIONS:				5861		312 <	429		0				377
	HANAPEPE-ELEELE SYSTEM													
303	HANAPEPE	0.0	0.0	0.0	87.3	0.0	0.0	0.0	0.0	0.0	0.0	23.2	0.0	0.0
304	HANAPEPE	0.0	46.7	4.5	15.7	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
101	HANAPEPE	0.0	0.0	32.4	103.0	22.8	0.0	2.3	0.0	0.0	18.1	1.6	0.0	0.0
	TOTAL AREA:(AC.)	0.0	46.7	36.9	205.0	26.1	0.0	2.3	0.0	0.0	18.1	24.8	0.0	0.0
	NUMBER OF UNITS:	0	93.4	148	1236	261	0	46	0	0	18.1	99.2	0	0
	TOTAL NUMBER OF UNITS:				1477			307		0				117
	TOTAL POPULATIONS:				4301		339 <	466		0				381

	2202 UNITS	1.19
	6980 PEOPLE	

WAIMEA WATER DISTRICT

POPULATION:	11827
USE (MGD):	2.21
MUNIC. RATE OF USE:	170.2

	1901 UNITS	1.02
	5987 PEOPLE	

45526 UNITS	20.10
122908 PEOPLE	

PROJECT TITLE: KAUAI WATER USE AND DEVELOPMENT PLAN JOB NO.: 1-15409-OE file: MELFPOP2.WK1
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: PROJECTED LONG RANGE WATER USE BY MUNICIPAL SYSTEM DATE: 16-FEB-90 REV: 07-MAY-90
DESCRIPTION: This spreadsheet tabulates the current population by municipal water system. This is then used to redistribute the projected long range water use by water district into water use by municipal system.

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	F-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P
	KALAHEO-LAWAI SYSTEM													
101	KALAHEO	4.4	128.6	374.5	54.9	3.0	0.0	2.6	0.0	0.0	0.0	15.9	1.5	0.0
101	LAWAI	0.0	14.9	161.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
101	OMAO	0.0	243.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	4.4	386.7	536.2	54.9	3.0	0.0	2.6	0.0	0.0	0.0	15.9	1.5	0.0
	NUMBER OF UNITS:	4.4	773.4	2145	329.46	30	0	52	0	0	0	63.6	9	0
	TOTAL NUMBER OF UNITS:				3252			82		0				73
	TOTAL POPULATIONS:				10569		91 <	124		0				236
	KOLOA-POIPU SYSTEM													
101	LAWAI-KUKUIULA	0.0	14.9	11.6	123.0	44.0	0.0	41.2	0.0	0.0	0.0	0.0	0.0	0.0
101	KOLOA	11.1	6.7	66.0	202.7	16.4	0.0	7.4	0.0	0.0	0.0	23.5	1.3	0.0
101	POIPU	0.0	0.0	35.6	35.5	160.1	0.0	71.1	30.2	53.9	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	11.1	21.6	153.2	361.2	220.5	0.0	119.7	30.2	53.9	0.0	23.5	1.3	0.0
	NUMBER OF UNITS:	11.1	43.2	653	2167.3	2205	0	2394	604	2156	0	94	7.8	0
	TOTAL NUMBER OF UNITS:				2874			4599		2760				102
	TOTAL POPULATIONS				9342		5082 <	6981		5078				331
	LIHUE SYSTEM													
102	HANAMAULU	0.0	0.0	17.2	136.9	15.3	0.0	2.1	0.0	0.0	0.0	0.0	6.0	0.0
102	LIHUE-KAPAIA	0.0	0.0	193.6	136.7	8.2	0.0	48.6	0.0	0.0	67.2	15.0	0.0	0.0
102	NAWILIWILI	0.0	1.8	65.1	33.0	0.0	0.0	4.0	0.0	92.0	38.0	0.0	0.0	0.0
102	PUHI	0.0	0.0	0.0	52.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	0.0	1.8	275.9	358.6	27.0	0.0	54.7	0.0	92.0	105.2	15.0	6.0	0.0
	NUMBER OF UNITS:	0	3.6	1104	2151.6	270	0	1094	0	3680	105.2	60	36	0
	TOTAL NUMBER OF UNITS:				3259			1364		3680				201
	TOTAL POPULATIONS:				10591		1507 <	2071		6771				654

	TOTALS	MUNICIPAL WATER USE (MGD)
	3407 UNITS	2.85
	11020 PEOPLE	
	10335 UNITS	6.94
	26814 PEOPLE	
	8504 UNITS	
	21594 PEOPLE	

KOLOA WATER DISTRICT
POPULATION: 63052
USE (MGD): 9.80
MUNIC. RATE OF USE: 259.0

LIHUE WATER DISTRICT
POPULATION: 42616
USE (MGD): 8.587124

PROJECT TITLE: KAUAI WATER USE AND DEVELOPMENT PLAN JOB NO.: 1-15409-0E file: MELFPOP2.WK1
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: PROJECTED LONG RANGE WATER USE BY MUNICIPAL SYSTEM DATE: 16-FEB-90 REV: 07-MAY-90
DESCRIPTION: This spreadsheet tabulates the current population by municipal water system. This is then used to redistribute the projected long range water use by water district into water use by municipal system.

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P
	WAILUA-KAPAA SYSTEM													
102	WAILUA-WAIPOULI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0
103	WAILUA	0.0	0.0	0.0	65.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
103	WAILUA HOMESTEADS	0.0	323.0	233.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
103	WAILUA-WAIPOULI	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	10.1	0.0	0.0	0.0	0.0
104	WAILUA-WAIPOULI	0.0	0.0	0.0	46.2	8.7	0.0	38.8	0.0	86.4	0.0	0.0	0.0	4.7
104	WAILUA	0.0	0.0	0.0	111.6	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.0
104	KAPAA	0.0	0.0	163.8	68.5	20.6	0.0	6.9	0.0	0.0	147.8	14.1	0.0	0.0
104	KAPAA HOMESTEADS	0.0	0.0	105.5	219.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	0.0	323.0	507.0	511.6	29.3	0.0	45.7	0.0	104.0	147.8	21.6	0.0	4.7
	NUMBER OF UNITS:	0	646	2028	3069.6	293	0	913.4	0	4160	147.8	86.4	0	47
	TOTAL NUMBER OF UNITS:				5744			1206		4160				281
	TOTAL POPULATIONS:				18667		1333 <	1831		7654				914
	ANAHOLA SYSTEM													
104	ANAHOLA	0.0	63.9	83.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0
	TOTAL AREA:(AC.)	0.0	63.9	83.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0
	NUMBER OF UNITS:	0	127.76	333	0	0	0	0	0	0	0	9.44	0	0
	TOTAL NUMBER OF UNITS:				461			0		0				9
	TOTAL POPULATIONS:				1497		0 <	0		0				31
	KILAUEA SYSTEM													
105	KILAUEA	0.0	0.0	47.6	77.4	0.0	0.0	0.0	0.0	0.0	0.0	8.4	0.0	0.0
201	KILAUEA	0.0	0.0	2.4	21.8	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0
	TOTAL AREA:(AC.)	0.0	0.0	50.0	99.2	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0
	NUMBER OF UNITS:	0	0	200	595.2	0	0	0	0	0	0	36	0	0
	TOTAL NUMBER OF UNITS:				795			0		0				36
	TOTAL POPULATIONS:				2584		0 <	0		0				117

11391 UNITS 5.62
30399 PEOPLE

KAWAIHAU WATER DISTRICT

POPULATION: 47609
USE (MGD): 5.90
MUNIC. RATE OF USE: 184.8

470 UNITS 0.28
1528 PEOPLE

831 UNITS 0.82
2701 PEOPLE

PROJECT TITLE: KAUAI WATER USE AND DEVELOPMENT PLAN JOB NO.: 1-15409-OE file: MELFPOP2.WK1
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: PROJECTED LONG RANGE WATER USE BY MUNICIPAL SYSTEM DATE: 16-FEB-90 REV: 07-MAY-90
DESCRIPTION: This spreadsheet tabulates the current population by municipal water system. This is then used to redistribute the projected long range water use by water district into water use by municipal system.

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P
	HANALEI-PRINCEVILLE SYSTEM													
201	PRINCEVILLE	0.0	0.0	151.0	0.0	83.0	43.7	0.0	0.0	20.5	0.0	0.0	0.0	0.0
202	PRINCEVILLE	0.0	0.0	69.0	0.0	29.8	16.6	6.2	59.2	16.5	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	0.0	0.0	220.0	0.0	112.8	60.3	6.2	59.2	37.0	0.0	0.0	0.0	0.0
	NUMBER OF UNITS:	0	0	880	0	1128	904.5	124	1184	1480	0	0	0	0
	TOTAL NUMBER OF UNITS:				880			2157		2664				0
	TOTAL POPULATIONS:				2860		2383 <	3274		4902				0
202	HANALEI TOWN	2.5	0.0	78.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	2.5	0.0	78.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	NUMBER OF UNITS:	2.5	0	314	0	0	0	0	0	0	0	0	0	0
	TOTAL NUMBER OF UNITS:				317			0		0				0
	TOTAL POPULATIONS:				1030		0 <	0		0				0
	WAINIHA-HAENA SYSTEM													
203	WAINIHA	66.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
203	WAINIHA-HAENA	0.0	15.3	77.9	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	66.9	15.3	77.9	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0
	NUMBER OF UNITS:	66.9	30.6	312	0	0	0	0	58	0	0	0	0	0
	TOTAL NUMBER OF UNITS:				409			0		58				0
	TOTAL POPULATIONS:				1330		0 <	0		107				0

HANALEI WATER DISTRICT

POPULATION:	36085	
USE (MGD):	5.61	
MUNIC. RATE OF USE:	301.7	
	5701 UNITS	4.05
	13418 PEOPLE	
	317 UNITS	0.31
	1030 PEOPLE	
	467 UNITS	0.43
	1436 PEOPLE	

PROJECT TITLE: KAUAI WATER USE AND DEVELOPMENT PLAN JOB NO.: 1-15409-0E file: MELFPOP2.WK1
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: PROJECTED LONG RANGE WATER USE BY MUNICIPAL SYSTEM DATE: 16-FEB-90 REV: 07-MAY-90
DESCRIPTION: This spreadsheet tabulates the current population by municipal water system. This is then used to redistribute the projected long range water use by water district into water use by municipal system.

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P
	KEKAHA-WAIMEA SYSTEM													
301	KEKAHA	0.0	0.0	94.8	136.7	20.8	0.0	0.0	0.0	0.0	0.0	0.0	7.2	1.5
301	WAIMEA	0.0	0.0	40.1	1.2	0.0	0.0	0.0	0.0	0.0	40.8	0.0	0.0	0.0
302	WAIMEA	0.0	71.7	64.1	0.0	7.5	0.0	0.0	0.0	0.0	17.1	0.0	0.0	0.0
303	WAIMEA	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL AREA:(AC.)	0.0	71.7	208.1	137.9	28.3	0.0	0.0	0.0	0.0	57.9	0.0	7.2	1.5
	NUMBER OF UNITS:	0	143.4	832	827.64	282.7	0	0	0	0	57.9	0	43.2	15
	TOTAL NUMBER OF UNITS:				1803			283		0				116
	TOTAL POPULATIONS:				5861		312	429		0				377
	HANAPEPE-ELEELE SYSTEM													
303	HANAPEPE	0.0	0.0	0.0	87.3	0.0	0.0	0.0	0.0	0.0	0.0	23.2	0.0	0.0
304	HANAPEPE	0.0	46.7	4.5	15.7	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
101	HANAPEPE	0.0	0.0	32.4	103.0	22.8	0.0	2.3	0.0	0.0	18.1	1.6	0.0	0.0
	TOTAL AREA:(AC.)	0.0	46.7	36.9	206.0	26.1	0.0	2.3	0.0	0.0	18.1	24.8	0.0	0.0
	NUMBER OF UNITS:	0	93.4	148	1236	261	0	46	0	0	18.1	99.2	0	0
	TOTAL NUMBER OF UNITS:				1477			307		0				117
	TOTAL POPULATIONS				4801		339	466		0				381

	2202 UNITS	2.89
	6980 PEOPLE	
	1901 UNITS	2.48
	5987 PEOPLE	
	45527 UNITS	35.26
	122909 PEOPLE	

WAIMEA WATER DISTRICT

POPULATION:	28766
USE (MGD):	5.37
MUNIC. RATE OF USE:	414.0

TABLE A-5

PROJECT TITLE: KAUAI WATER STUDY JOB NO.: 1-15409-0E file: KAUAIWSF.WK1
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: HYDROLOGIC SYSTEMS DATE: 01-JAN-90 (REVISED SUMMARY) REVISED 07-MAY-90

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	C-N	C-G	I-L	I-G	R-6/ PD	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P	A	C-N/ PD	R-10/ PD	PD-C	PD/ ST-C	C-G/ ST-P	C-G/ PD
101	HANAPEPE	0.0	0.0	32.1	103.0	22.8	0.0	2.3	0.0	0.0	0.0	26.8	2.4	31.8	0.0	18.1	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
101	KALAHEO	4.4	128.6	374.5	54.9	3.0	0.0	2.6	0.0	0.0	1.3	21.4	0.0	0.0	1.6	0.0	15.9	1.5	0.0	5.9	0.0	0.0	0.0	0.0	3.7	0.0
101	KOLOA	11.1	6.7	66.1	202.7	16.4	0.0	7.4	0.0	0.0	1.1	23.2	0.0	0.0	0.0	0.0	23.5	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
101	LAWAI	0.0	14.9	161.7	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	20.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3	0.0	0.0	0.0
101	LAWAI-KUKUIULA	0.0	14.9	11.3	123.0	44.0	0.0	41.2	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0
101	OMAO	0.0	243.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
101	POIPU	0.0	0.0	85.8	35.5	180.1	0.0	71.1	30.2	53.9	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		15.5	108.3	731.0	519.1	246.3	0.0	124.6	30.2	53.9	20.8	71.4	2.4	31.8	22.2	18.1	41.0	2.8	0.0	11.9	0.0	0.0	12.3	0.0	3.7	0.0
102	HANAMAULU	0.0	0.0	17.2	136.9	15.3	0.0	2.1	0.0	0.0	3.4	0.0	0.0	10.8	0.0	0.0	0.0	6.0	0.0	4.1	0.0	0.0	0.0	0.0	0.0	0.0
102	LIHUE-KAPAIA	0.0	0.0	193.8	136.7	8.2	0.0	48.6	0.0	0.0	0.0	257.5	0.0	13.5	0.0	67.2	15.0	0.0	0.0	17.7	0.0	0.0	0.0	0.0	0.0	0.0
102	NAWILIWILI	0.0	1.8	65.1	33.0	0.0	0.0	4.0	0.0	92.0	8.0	0.0	60.6	77.7	0.0	38.0	0.0	0.0	0.0	56.0	0.0	0.0	0.0	0.0	0.0	0.0
102	PUHI	0.0	0.0	0.0	52.0	3.5	0.0	0.0	0.0	0.0	4.3	0.0	4.5	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
102	WAILUA-WAIPOULI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	1.8	275.1	358.6	27.0	0.0	54.7	0.0	99.5	15.7	257.5	65.1	110.5	0.0	105.2	15.0	6.0	0.0	77.8	0.0	0.0	0.0	0.0	0.0	0.0
103	WAILUA	0.0	0.0	0.0	65.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
103	WAILUA HOMESTEADS	0.0	323.0	233.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
103	WAILUA-WAIPOULI	0.0	0.0	3.1	0.0	0.0	0.0	0.0	0.0	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	323.0	237.7	65.8	0.0	0.0	0.0	0.0	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
104	AHAHOLA	0.0	63.9	83.2	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
104	KAPAA	0.0	0.0	163.3	68.5	20.6	0.0	6.9	0.0	0.0	0.0	23.2	23.3	0.0	35.6	147.8	14.1	0.0	0.0	3.4	0.0	0.0	0.0	0.0	1.0	0.0
104	KAPAA HOMESTEADS	0.0	0.0	105.3	219.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.3	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
104	WAILUA	0.0	0.0	0.0	111.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
104	WAILUA-WAIPOULI	0.0	0.0	0.0	46.2	8.7	0.0	38.8	0.0	86.4	6.3	32.6	5.5	0.0	0.0	0.0	0.0	0.0	4.7	10.3	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	63.9	352.5	445.8	29.3	0.0	45.7	0.0	86.4	8.5	55.8	40.1	0.6	35.6	147.8	24.0	0.0	4.7	13.7	0.0	0.0	0.0	0.0	1.0	0.0
105	KILAUEA	0.0	0.0	47.3	77.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	0.0	0.0	1.4	4.6	2.5	0.0	0.0	0.0	0.0
201	KILAUEA	0.0	0.0	2.1	21.8	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	17.0	6.0	0.0	0.0	0.0	0.0	0.0
201	PRINCEVILLE	0.0	0.0	151.1	0.0	33.0	43.7	0.0	0.0	20.5	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7
		0.0	0.0	153.1	21.8	33.0	43.7	0.0	0.0	20.5	1.2	0.6	0.0	0.0	0.0	0.0	0.6	0.0	0.0	17.0	6.0	0.0	0.0	0.0	0.0	6.7

TABLE A-5

PROJECT TITLE: KAUAI WATER STUDY JOB NO.: 1-15409-0E file: KAUAIWSF.WK1
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: HYDROLOGIC SYSTEMS DATE: 01-JAN-90 (REVISED SUMMARY) REVISED 07-MAY-90

HYD SYS NO.	MAP	R-1	I-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	C-N	C-G	I-L	I-G	R-6/ PD	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P	A	C-N/ PD	R-10/ PD	PD-C	PD/ ST-C	C-G/ ST-P	C-G/ PD
202	HANALEI TOWN	2.5	0.0	78.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	6.7	0.0	0.0	0.0	0.0	3.8
202	PRINCEVILLE	0.0	0.0	69.0	0.0	25.8	16.6	6.2	59.2	16.5	0.0	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		2.5	0.0	147.6	0.0	25.8	16.6	6.2	59.2	16.5	0.0	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	6.7	0.0	0.0	0.0	0.0	3.8
203	WAINIHA	66.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
203	WAINIHA-HAENA	0.0	15.3	77.9	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		66.9	15.3	77.9	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
301	KEKAHA	0.0	0.0	94.8	136.7	20.8	0.0	0.0	0.0	0.0	9.8	0.0	0.0	26.1	15.3	0.0	0.0	7.2	1.5	5.5	0.0	0.0	0.0	0.0	0.0	0.0
301	WAIMEA	0.0	0.0	40.1	1.2	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	65.8	40.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0
		0.0	0.0	134.9	137.9	20.8	0.0	0.0	0.0	0.0	9.8	4.0	0.0	26.1	81.1	40.8	0.0	7.2	1.5	5.5	0.0	0.0	0.0	1.4	0.0	0.0
302	WAIMEA	0.0	71.7	64.1	0.0	7.5	0.0	0.0	0.0	0.0	0.0	12.9	0.0	0.0	0.0	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
303	HANAPEPE	0.0	0.0	0.0	87.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.2	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
303	WAIMEA	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	9.1	87.3	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	23.2	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
304	HANAPEPE	0.0	46.7	4.5	15.7	3.3	0.0	0.0	0.0	0.0	0.0	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		84.9	930.7	2237.0	1729.5	447.0	60.3	231.2	92.3	286.9	55.9	439.4	107.6	169.0	138.9	329.0	112.2	16.0	6.2	133.4	17.3	2.5	12.3	1.4	4.7	10.5

TABLE A-6

PROJECT TITLE: KAUAI WATER USE AND DEVELOPMENT PLAN
LOCATION: KAUAI, HAWAII
ITEM: HYDROLOGIC SYSTEMS - 20 YEAR
(REVISED SUMMARY)

JOB NO.: 1-15409-0E
PREPARED BY:
DATE: 1-FEB-90 REV: 07-MAY-90
file: MELHYDSY.WK1

ZONE	SYSTEM FUTURE POPULATIONS											
	101	102	103	104	105	201	202	203	301	302	303	304
R-1	109	342	0	480	0	0	8	217	24	10	0	0
R-2	2654	12	2100	415	0	0	0	99	0	466	0	304
R-4	10047	3782	3090	4893	728	2002	1919	1013	1754	833	420	59
R-6	10611	7110	1283	9387	1509	425	0	0	4412	0	1702	306
R-10	2722	298	0	376	28	917	329	0	246	83	0	36
	2991	328		413	30	1008	362		270	91		40
R-15	0	0	0	0	0	724	275	0	0	0	0	0
	0	0				796	302					
R-20	2754	1209	0	1009	0	0	137	0	0	0	0	0
	3026	1329		1109			151					
RR-10	1111	0	0	0	0	0	2179	107	0	0	0	0
RR-20	3967	7323	743	6359	0	1509	1214	0	0	0	0	0
C-N	0	47	0	25	0	4	0	0	29	0	0	0
C-G	0	1288	0	279	0	3	77	0	20	65	5	105
I-L	0	260	0	160	0	0	0	0	0	0	0	0
I-G	0	663	0	4	0	0	0	0	157	0	0	0
A	0	233	0	41	4	51	11	0	17	0	7	0
ST-SP	0	296	0	19	34	2	0	0	192	68	0	0
RESIDENT	28896	12752	6473	16561	2265	4069	2668	1330	6436	1392	2122	705
VISITOR	11096	8980	743	7881	30	3313	4208	107	270	91	0	40
TOTAL	39992	21732	7216	24443	2295	7381	6876	1436	6706	1484	2122	745

SYS	POP	USE (MGD)
101	34989.1	5.437
102	29931.7	6.031
103	6924.5	0.892
104	23454.8	2.906
105	2552.2	0.397
201	8207.7	1.275
202	7646.0	1.188
203	1597.1	0.248
301	5584.9	1.042
302	1235.5	0.231
303	1767.2	0.330
304	620.2	0.116
	124.5	20.093

TOTALS
85669
36759
122428

TABLE A-7

PROJECT TITLE: KAUAI WATER STUDY
LOCATION: KAUAI, HAWAII
ITEM: HYDROLOGIC SYSTEMS - ULTIMATE FUTURE
(REVISED SUMMARY)

JOB NO.: 1-15409-0E
PREPARED BY:
DATE: 16-FEB-90 REV: 07-MAY-90
file: MELHYDS2.WK1

ZONE	SYSTEM FUTURE POPULATIONS											
	101	102	103	104	105	201	202	203	301	302	303	304
R-1	109	342	0	480	0	0	8	217	24	10	0	0
R-2	2654	12	2100	415	0	0	0	99	0	466	0	304
R-4	10047	3782	3090	4893	728	2002	1919	1013	1754	833	420	59
R-6	10611	7110	1283	9387	1509	425	0	0	4412	0	1702	306
R-10	2722	298	0	376	28	917	329	0	246	83	0	36
	2991	328		413	30	1008	362		270	91		40
R-15	0	0	0	0	0	724	275	0	0	0	0	0
	0	0				796	302					
R-20	2754	1209	0	1009	0	0	137	0	0	0	0	0
	3026	1329		1109			151					
RR-10	1111	0	0	0	0	0	2179	107	0	0	0	0
RR-20	3967	7323	743	6359	0	1509	1214	0	0	0	0	0
C-N	0	47	0	25	0	4	0	0	29	0	0	0
C-G	0	1288	0	279	0	3	77	0	20	65	5	105
I-L	0	260	0	160	0	0	0	0	0	0	0	0
I-G	0	663	0	4	0	0	0	0	157	0	0	0
A	0	233	0	41	4	51	11	0	17	0	7	0
ST-SP	0	296	0	19	34	2	0	0	192	68	0	0
RESIDENT	28896	12752	6473	16561	2265	4069	2668	1330	6436	1392	2122	705
VISITOR	11096	8980	743	7881	30	3313	4208	107	270	91	0	40
TOTAL	39992	21732	7216	24443	2295	7381	6876	1436	6706	1484	2122	745

SYS	POP.	USE (MGD)
101	69422.4	10.788
102	43431.9	8.752
103	10665.7	1.321
104	36127.4	4.476
105	4604.2	0.715
201	14806.5	2.301
202	13793.2	2.143
203	2881.1	0.448
301	13583.8	2.535
302	3005.0	0.561
303	4298.4	0.802
304	1508.5	0.281
	218.1	35.124

TOTALS
85669
36759
122428

TABLE A-8

PROJECT TITLE: KAUAI WATER STUDY JOB NO.: 1-15409-0E file: tommy212
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: ESTIMATED DENSITIES DATE: 02-12-90 REV: 05-12-90 (REVISED SUMMARY)

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	C-N	C-G	I-L	I-G	R-6/ PD	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	I-10/ ST-P	A	C-N/ PD	R-10/ PD	PD-C	PD/ ST-C	C-G/ ST-P	C-G/ PD
101	HANAPEPE not used	0.0	0.0	32.4	103.0	22.8	0.0	2.3	0.0	0.0	0.0	26.8	2.4	31.8	0.0	18.1	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
101	KALAHEO	4.4	128.6	374.5	54.9	3.0	0.0	2.6	0.0	0.0	1.3	21.4	0.0	0.0	1.6	0.0	15.9	1.5	0.0	5.9	0.0	0.0	0.0	0.0	3.7	0.0
101	KOLOA	11.1	6.7	66.0	202.7	16.4	0.0	7.4	0.0	0.0	1.1	23.2	0.0	0.0	0.0	0.0	23.5	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
101	LAWAI	0.0	14.9	161.7	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	20.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3	0.0	0.0	0.0
101	LAWAI-KUKUIULA	0.0	14.9	11.6	123.0	44.0	0.0	41.2	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0
101	ONAO	0.0	243.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
101	POIPU	0.0	0.0	85.6	35.5	160.1	0.0	71.1	30.2	53.9	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	total koloa	15.5	408.3	699.4	416.1	223.5	0.0	122.3	30.2	53.9	20.8	44.6	0.0	0.0	22.2	0.0	39.4	2.8	0.0	11.9	0.0	0.0	12.3	0.0	3.7	0.0
	not used	7.8	101.9	175.7	286.0	141.8		60.1							11.3		14.0									
	net area	7.7	306.4	523.7	150.2	81.7	0.0	62.2	30.2	53.9	20.8	44.6	0.0	0.0	10.9	0.0	25.4	2.8	0.0	11.9	0.0	0.0	12.3	0.0	3.7	0.0
	units	7.7	612.8	2094.9	901.0	816.6	0.0	1243.	604.0	2156					65.2	0.0	101.7	16.8	0.0			0.0				

	units	units from traffic study	area	units per acre	
single family	3800.	1987	1348.	6.393	as zoned
multifamily	2059.	2434			
resort	2760	986		4.010	as described in traffic study

land in koloa resort areas

land area	0	0	63.719	0	49.47	0	64.19	30.2	53.91	10.1																
units	0.0	0.0	254.9	0.0	494.7	0.0	1283.	604.0	2156.					0.0	0.0	0.0	0.0	0.0			0.0					

	units	acres	units per acre	units per acre with kiahuna GC added
max zoned units	4793.	345.18	13.88	11.01
estimated actual units from traffic study and zoning maps	3377	345.18	9.783	7.759

TABLE A-8

PROJECT TITLE: KAUAI WATER STUDY JOB NO.: 1-15409-0E File: tommy212
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: ESTIMATED DENSITIES DATE: 12-12-90 REV: 05-12-90 (REVISED SUMMARY)

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	C-N	C-G	I-L	I-G	R-0/ PD	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P	A	C-N/ PD	R-10/ PD	PD-C	PD/ ST-C	C-G/ ST-P	C-G/ PD
102	HANAMAULU	0.0	0.0	17.2	136.9	15.3	0.0	2.1	0.0	0.0	3.4	0.0	0.0	10.8	0.0	0.0	0.0	6.0	0.0	4.1	0.0	0.0	0.0	0.0	0.0	0.0
102	LIHUE-KAPAIA	0.0	0.0	193.6	136.7	8.2	0.0	48.6	0.0	0.0	0.0	257.5	0.0	13.5	0.0	67.2	15.0	0.0	0.0	17.7	0.0	0.0	0.0	0.0	0.0	0.0
102	NAWILIWILI	0.0	1.8	65.1	33.0	0.0	0.0	4.0	0.0	92.0	8.0	0.0	60.6	77.7	0.0	38.0	0.0	0.0	0.0	56.0	0.0	0.0	0.0	0.0	0.0	0.0
102	PUHI	0.0	0.0	0.0	52.0	3.5	0.0	0.0	0.0	0.0	4.3	0.0	4.5	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
102	WAILUA-WAIPOULI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	total lihue	0.0	1.8	275.9	358.6	27.0	0.0	54.7	0.0	99.5	15.7	257.5	65.1	110.5	0.0	105.2	15.0	6.0	0.0	77.8	0.0	0.0	0.0	0.0	0.0	0.0
	not used	0.0	0.0	77.6	31.8	17.9		12.2		58.8			8.2	12.0	0.0		0.0	6.6								
	net area	0.0	1.8	198.3	326.8	9.1	0.0	42.5	0.0	40.7	15.7	257.5	56.9	98.5	0.0	105.2	15.0	-0.6	0.0	77.8	0.0	0.0	0.0	0.0	0.0	
	units	0.0	3.6	793.1	1960.9	90.8	0.0	850	0.0	1628					0.0	105.2	60.0	-3.9	0.0			0.0				
	area in lihue	0.0	1.8	181.1	166.7	8.2	0.0	40.4	0.0	33.2	8.0	257.5	55.9	91.2	0.0	105.2	15.0	0.0	0.0	73.7	0.0	0.0	0.0	0.0	0.0	
	units in lihue	0.0	3.6	724.3	1000.4	82.0	0.0	808	0.0	1328					0.0	105.2	60.0	0.0	0.0			0.0				

	units	units in lihue	lihue UMU acreage
single family	2918.	1893.5	931.0
multifamily	940.6	890	
resort	1628	1328	2.989 units per acre

note: UMU alos includes Open lands which will decrease units per acre more.

units from traffic stuty

single family	1396.	2.222 units per acre
multi family	673	per traffic study
resort	1400	

PROJECT TITLE: KAUAI WATER STUDY JOB NO.: 1-15409-OE file: tommy212
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: ESTIMATED DENSITIES DATE: 01-12-90 REV: 05-12-90 (REVISED SUMMARY)

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	C-N	C-G	I-L	I-G	R-6/ PD	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P	A	C-N/ PD	R-10/ PD	PD-C	PD/ ST-C	C-G/ ST-P	C-G/ PD
103	WAILUA	0.0	0.0	0.0	65.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
103	WAILUA HOMESTEADS	0.0	323.0	233.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
103	WAILUA-WAIPOULI	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	323.0	237.7	65.8	0.0	0.0	0.0	0.0	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
104	ANAHOLA	0.0	63.9	83.2	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
104	KAPAA	0.0	0.0	163.8	68.5	20.6	0.0	6.9	0.0	0.0	0.0	23.2	23.3	0.0	35.6	147.8	14.1	0.0	0.0	3.4	0.0	0.0	0.0	0.0	1.0	0.0
104	KAPAA HOMESTEADS	0.0	0.0	105.5	219.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.3	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
104	WAILUA	0.0	0.0	0.0	111.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
104	WAILUA-WAIPOULI	0.0	0.0	0.0	46.2	8.7	0.0	38.8	0.0	86.4	6.8	32.6	5.5	0.0	0.0	0.0	0.0	0.0	4.7	10.3	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	63.9	352.5	445.8	29.3	0.0	45.7	0.0	86.4	8.5	55.8	40.1	0.6	35.6	147.8	24.0	0.0	4.7	13.7	0.0	0.0	0.0	0.0	1.0	0.0
	total kawaihau	0	386.8	590.16	511.6	29.3	0	45.67	0	96.5	8.45	55.8	40.1	0.6	35.6	147.8	21.96	0	4.7	13.7	0	0	0	0	0.97	0
	not used	0.0	140.0	95.7	71.0	0.0		7.1		14.8			0.9	0.0	0.0	118.3	2.7	0.0	4.7							
	net area	0.0	246.9	494.5	440.6	29.3	0.0	38.6	0.0	81.7	8.5	55.8	39.2	0.6	35.6	29.6	21.3	0.0	0.0	13.7	0.0	0.0	0.0	0.0	1.0	
	units	0.0	493.8	1978.0	1643.5	293.0	0.0	771.6	0.0	3266.					213.6	29.6	65.2	0.0	0.4			0.0				

	units	actual units	acres	
single family	5444.	2496	1536.7	1.3613 units per acre zoned
multifamily	1064.	898		
resort	3266.	1647		2.2803 units per acre based on traffic study
	9775.	5041		

TABLE A-8

PROJECT TITLE: KAUAI WATER STUDY JOB NO.: 1-15409-0E file: tomm/212
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: ESTIMATED DENSITIES DATE: 02-12-90 REV: 05-12-90 (REVISED SUMMARY)

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	C-N	C-G	I-L	I-G	R-6/ PD	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P	A	C-N/ PD	R-10/ PD	PD-C	PD/ ST-C	C-G/ ST-P	C-G/ PD
105	KILAUEA	0.0	0.0	47.6	77.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	0.0	0.0	1.4	4.8	2.5	0.0	0.0	0.0	0.0
201	KILAUEA	0.0	0.0	2.4	21.8	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	17.0	6.0	0.0	0.0	0.0	0.0	0.0
201	PRINCEVILLE	0.0	0.0	151.0	0.0	83.0	43.7	0.0	0.0	20.5	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7
		0.0	0.0	153.4	21.8	83.0	43.7	0.0	0.0	20.5	1.2	0.6	0.0	0.0	0.0	0.0	0.6	0.0	0.0	17.0	6.0	0.0	0.0	0.0	0.0	6.7
202	HANALEI TOWN	2.5	0.0	78.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	6.7	0.0	0.0	0.0	0.0	3.8
202	PRINCEVILLE	0.0	0.0	69.0	0.0	29.8	16.6	5.2	59.2	16.5	0.0	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		2.5	0.0	147.6	0.0	29.8	16.6	5.2	59.2	16.5	0.0	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	6.7	0.0	0.0	0.0	0.0	3.8
203	WAINIHA	66.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
203	WAINIHA-HAENA	0.0	16.3	77.9	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		66.9	16.3	77.9	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
total hanalei		69.4	16.3	426.5	99.2	112.8	60.3	5.2	62.1	37	1.19	15.9	0	0	0	0	9	0	0	22.2	17.3	2.5	0	0	0	10.5
not used		46.9	11.0	139.0	0.0	29.9	14.6	5.8	38.5	20.5			0.0	0.0	0.0		0.0	0.0								
net area		22.5	-1.7	287.5	99.2	82.9	45.7	0.4	23.6	16.5	1.2	15.9	0.0	0.0	0.0	0.0	9.0	0.0	0.0	22.2	17.3	2.5	0.0	0.0	0.0	
units		22.5	-1.5	1149.9	595.2	829.2	686.	7.195	472.4	660.8					0.0	0.0	36.0	0.0	0.0			25.0				
net area in princeville		0	0	220	0	82.92	45.7	0.359	20.72	16.52	0	15.9	0	0	0	0	0	0	0	0	0	0	0	0	0	6.7
units		0.0	0.0	880.0	0.0	829.2	686.	7.195	414.4	660.8					0.0	0.0	0.0	0.0	0.0			0.0				

	units	units in princeville as zoned	total acreage	
single family	1796.	880	292.1	50% of r4 assumed not used
multifamily	1547.	1522.		
resort	1133.	1075.	11.90	units per acre
		3477.	7.865	units per acre with golf course
		actual units		
		865	292.1	50% of r4 assumed unused
		1250		
		300	8.266	units per acre without golf course
		2415	5.461	units per acre with golf course

TABLE A-8

PROJECT TITLE: KAUAI WATER STUDY JOB NO.: 1-15409-0E file: tomay212
LOCATION: KAUAI, HAWAII PREPARED BY:
ITEM: ESTIMATED DENSITIES DATE: 02-12-90 REV: 05-12-90 (REVISED SUMMARY)

HYD SYS NO.	MAP	R-1	R-2	R-4	R-6	R-10	R-15	R-20	RR-10	RR-20	C-N	C-G	I-L	I-G	R-6/ PD	R-1/ ST-P	R-4/ ST-P	R-6/ ST-P	R-10/ ST-P	A	C-N/ PD	R-10/ PD	PD-C	PD/ ST-C	C-G/ ST-P	C-G/ PD
301	KEKAHA	0.0	0.0	94.8	136.7	20.8	0.0	0.0	0.0	0.0	9.8	0.0	0.0	26.1	15.3	0.0	0.0	7.2	1.5	5.5	0.0	0.0	0.0	0.0	0.0	0.0
301	WAIMEA	0.0	0.0	40.1	1.2	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	65.8	40.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0
		0.0	0.0	134.9	137.9	20.8	0.0	0.0	0.0	0.0	9.8	4.0	0.0	26.1	81.1	40.8	0.0	7.2	1.5	5.5	0.0	0.0	0.0	1.4	0.0	0.0
302	WAIMEA	0.0	71.7	64.1	0.0	7.5	0.0	0.0	0.0	0.0	0.0	12.9	0.0	0.0	0.0	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
303	HANAPEPE	0.0	0.0	0.0	87.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.2	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
303	WAIMEA	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.0	9.1	87.3	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	23.2	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
304	HANAPEPE	0.0	46.7	4.5	15.7	3.3	0.0	0.0	0.0	0.0	0.0	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
total waimea		0	71.7	208.1	225.24	28.27	0	0	0	0	9.8	17.8	0	26.1	81.1	57.9	23.19	7.2	1.5	7.8	0	0	0	1.4	0	0
not used		0.0	97.8	16.6	36.4	17.6		2.7		0.0			2.8	0.0	0.0		0.0	8.4								
net area		0.0	-23.1	191.5	188.9	10.6	0.0	-2.7	0.0	0.0	9.8	17.8	-2.8	26.1	81.1	57.9	23.2	-1.2	1.5	7.8	0.0	0.0	0.0	1.4	0.0	
units		0.0	-57.2	766.0	1133.3	106.2	0.0	-54.5	0.0	0					486.6	57.9	92.8	-7.2	15.0			0.0				

	units	acres	units per acre
single family	2492.	584.7	4.3761 as zoned
multifamily	66.66		
resort	0		3.1930 per traffic study
	2558.		
actual units	1867		

TABLE A-9

Kauai Water Use and Development Plan
WATER DEMAND SUMMARY (per Municipal System)

Municipal System	Well Cap. (MGD)	Water Demand (MGD) 1988	2010	Ultimate
Kekaha-Waimea	3.07	1.18	1.19	2.89
Hanapepe-Eleele	2.25	0.52	1.02	2.48
Koloa-Poipu	5.99	1.73	3.56	6.94
Kalaheo-Lawai	3.99	0.77	1.46	2.85
Lihue	6.94	2.45	5.92	8.59
Wailua-Kapaa	8.35	2.49	3.65	5.62
Anahola	0.72	0.13	0.18	0.28
Kilauea	2.02	0.28	0.45	0.82
Hanalei-Princeville	0.36	0.88	2.41	4.36
Wainiha-Haena	0.52	0.09	0.24	0.43
TOTALS:	34.21	10.52	20.08	35.26

Note: The above figures include Princeville.

KAUAI

AQUIFER SYSTEM SUSTAINABLE YIELDS

The sustainable yields of groundwater for the Aquifer Systems of Kauai are difficult to estimate because of the complex relationships among the various types of groundwater and between groundwater and surface water. Wherever the Koloa volcanics are the dominant rock type, perched groundwater is widespread in discontinuous aquifers and masks the presence of basal water. Beneath the aquifers in the Koloa formation, high level and basal groundwater may exist in the basement rock of the Napali volcanics. Adding to the uncertainties of water provenance are numerous large perennial streams which drain high level and perched aquifers.

The Koloa formation dominates all of the Aquifer Systems of the Lihue Aquifer Sector. It is also hydrogeologically important in the Hanapepe and Makaweli Systems of the Waimea Aquifer Sector. In the Lihue Sector the estimated sustainable yields are derived on the assumption that exploitable basal lenses exist. However, nowhere has an extensive lens been discovered.

The major streams and most minor ones are sustained in large measure by groundwater drainage. The streams of the western half of the island receive high level dike-impounded water, while those in the east are fed by high level dike aquifers in the interior and perched aquifers in the lower lands. As much as 75 percent of the rainfall completes its path in the hydrologic

cycle as streamflow in the region dominated by Koloa rocks; about 50 percent flows away where streams cut the rift zone of the Waimea Canyon volcanic series in the western part of the island.

Although a large fraction of stream outflow is derived from groundwater, this fraction is included in total groundwater flux in the computation of estimated sustainable yields. If the sustainable yields were realizable, stream flows would decrease in some proportion.

Aquifer Sector: Lihue

Aquifer System: Koloa[20101]

Groundwater occurrence and behavior is controlled by the Koloa formation which covers the System except for isolated ridges of the Napali volcanics located inland. Perched and basal groundwaters occur in the Koloa, and high level and basal groundwaters probably exist in the Napali formation below its contact with the Koloa. The coast is not rimmed with sediments.

The estimated sustainable yield of 30 mgd assumes capture of infiltration before it drains into streams. The estimate is speculative.

Aquifer System: Hanamaulu[20102]

Virtually the entire System is mantled with the Koloa formation. The major stream valleys contain tongues of alluvium which are not effective as caprock. Perched water in the Koloa is the most common type of groundwater, but basal water occurs near

the coast.

As in the Koloa System the estimated sustainable yield of 40 mgd includes stream flow that once was groundwater. It is not a reliable estimate.

Aquifer System: Wailua[20103]

The drainage basin of the Wailua River comprises the System. Drainage is chiefly from the Koloa volcanics, but important input of high level dike water from Napali rocks in the interior contributes to stream flow. The perched and dike water are responsible for a large base flow in the river. Basal groundwater occurs near the coast.

The estimated sustainable yield of 60 mgd includes groundwater which eventually leaves the System as streamflow. The estimate is not reliable.

Aquifer System: Anahola[20104]

The System includes a segment of Napali volcanics in the Makaleha Mountains but chiefly consists of Koloa rocks. Large patches of sediments also occur but do not behave as caprock. High level dike groundwater exists in the Makaleha Mountains, while perched aquifers are common in the Koloa formation. A basal lens in the Koloa lies near the coast.

The sustainable yield was computed as if exploitable basal water were in the Koloa formation. The estimate of 36 mgd is not reliable.

Aquifer System: Kilauea[20105]

Numerous small streams and the larger Kilauea Stream drain the System. The Koloa formation is dominant; segments of Napali rocks are exposed in the interior. A small quantity of sediments occurs, but none form a caprock.

Perched and basal aquifers occur in the Koloa. The speculative estimated sustainable yield of 17 mgd refers to basal conditions.

Aquifer Sector: Hanalei

Aquifer System: Kalihiwai[20201]

The drainage basin of Kalihiwai Stream constitutes most of the System. The Koloa formation covers almost the entire basin. Basal water occurs near the coast and perched aquifers inland.

The sustainable yield of 16 mgd is an estimate based on the assumption that all groundwater becomes basal before discharging at the coast. The estimate is not reliable.

Aquifer System: Hanalei[20202]

Except for isolated patches of the Koloa series, the System is covered by the Olokele formation and the Napali member of the Waimea Canyon volcanic series. Alluvium covers major valley floors and forms a coastal plain at the mouth of Hanalei River,

but it is not an effective caprock. High level dike water drains to Hanalei. Toward the coast dikes occur, but the groundwater becomes basal.

The estimated sustainable yield of 35 mgd depends on movement of all groundwater to the basal zone. Hanalei River, however, captures much groundwater drainage. The estimate is not reliable.

Aquifer System: Wainiha[20203]

Two major rivers, Lumahai and Wainiha, drain a terrain almost exclusively composed of formations in the Waimea Canyon volcanic series. In the interior high level water drains from the Olokele member, while toward the coast a rift zone of the Napali member is cut by streams. The deep valleys contain old and recent alluvium, but these sediments do not act as a caprock.

The sustainable yield estimate of 24 mgd assumes exploitation of basal conditions in the rift zone toward the coast. If groundwater were to be developed, it would be preferable to seek high level dike water. The estimate is poor.

Aquifer Ssytem: Napali[20204]

Only the Napali is exposed as basement rock. The region, on the edge of the caldera of the principal volcano, is part of the dike complex of the rift zone. Sediments occur in Kalalau and smaller valleys but do not behave as caprock.

The estimated sustainable yield of 20 mgd is conjectural.

The mode of occurrence of groundwater in the System has not been explored.

Aquifer Sector: Waimea

Aquifer System: Kekaha[20301]

Kekaha is the only System in all of Kauai having a clearly defined basal lens protected by a thick sedimentary caprock at the coast. The basement rock, which is exposed above an elevation of about 100 feet, is the Napali basalt member of the Waimea Canyon volcanic series. A weak rift zone strikes from the caldera area at the head of the Waimea River drainage.

A basal lens underlies the caprock and extends an unknown distance inland. The estimated sustainable yield of 12 mgd refers to basal water. The entire sustainable yield is developed primarily for sugar cane irrigation and partly for domestic use. Much of the water pumped for irrigation is not potable. The estimate is fair.

Aquifer System: Waimea[20302]

The drainage basin of the Waimea River comprises the System. The origin of the river is in the caldera of the main volcano which is covered by the Olokele member of the Waimea Canyon volcanic series. The lower two thirds of the river flows through the Waimea Canyon in which Napali rocks are exposed. Dikes

intrude the volcanic formations throughout the System.

The estimated sustainable yield of 42 mgd assumes groundwater development from a basal lens. Much high level groundwater occurs in the interior, but the extent of basal conditions is uncertain. The estimate is speculative.

Aquifer System: Makaweli[20303]

The drainage between the Waimea and Hanapepe Rivers is included in the Makaweli System. The Makaweli and its principal tributary, Olokele, drain most of the region. The Makaweli joins the Waimea River one mile from the coast.

The most extensive formation is the Makaweli member of the Waimea Canyon volcanic series. The headwaters of the Makaweli River reach into both the Napali and Olokele members of the same series. The coastal area is covered by the Koloa volcanic series, which reaches as far as five miles inland. Sediments form the floors of the larger valleys but do not behave as caprock.

The sustainable yield of 30 mgd refers to basal groundwater. The estimate is poor.

Aquifer System: Hanapepe[20304]

The drainage basin of the Hanapepe River comprises the System. The interior two thirds of the drainage is covered by the Napali member that probably carries high level dike water. The lower third drains a Koloa terrain. A tongue of alluvium in the valley extends about five miles inland but is not a caprock.

The estimated sustainable yield of 26 mgd assumes development of basal water. It is not reliable.

Table A-10

Table A-11

Sustainable Yields for Kauai Hydrologic Units

System	Area (Sq. Mi.)	Surface (mgd)	Ground (mgd)	Total (mgd)
20101	50.72	21.7	30	51.7
20102	55.22	34.2	40	74.2
20103	52.46	147.4	60	207.4
20104	49.89	30.9	36	66.9
20105	18.63	16.8	17	33.8
		Total Sector 201		434.0
20201	17.69	30.3	19	46.3
20202	32.81	151.5	35	186.5
20203	38.69	252.4	24	276.4
20204	33.75	12.8	20	32.8
		Total Sector 202		524.0
20301	59.22	2.8	12	14.8
20302	48.4	43.8	42	85.8
20303	67.76	22.6	30	52.6
20304	22.35	43.6	26	69.6
		Total Sector 203		222.8

Table A-12

KAUAI

Estimated Sustainable Yields by Aquifer Systems

Sector	System	Code	A(sq.mi)	P(in/yr)	RO(in/yr)	ET(in/yr)	I(in/yr)	I(mgd)	SY(mgd)	h(0)	Con.Lev.	Ref.
Lihue	Koloa	20101	50.72	73	9	40	24	59	30	15	3	1
Lihue	Hanamaulu	20102	55.22	83	13	40	30	79	40	15	3	1
Lihue	Waialua	20103	52.46	146	59	40	47	117	60	15	3	1
Lihue	Anahola	20104	49.89	83	13	40	30	71	36	15	3	1
Lihue	Kilauea	20105	18.63	96	19	40	37	33	17	15	3	1
		Total:	226.92					359	183			
Hanalei	Kalihiwai	20201	17.69	121	36	40	45	38	16	20	3	1
Hanalei	Hanalei	20202	32.81	176	97	40	39	61	35	20	3	1
Hanalei	Wainiha	20203	38.69	200	137	40	23	42	24	20	3	1
Hanalei	Napali	20204	33.75	70	8	40	22	35	20	20	3	1
		Total:	122.94					176	95			
Waimea	Kekaha	20301	59.22	33	1	24	8	23	12	10	3	1
Waimea	Waimea	20302	48.40	95	19	40	36	83	42	10	3	1
Waimea	Makaweli	20303	67.76	65	7	40	18	58	30	10	3	1
Waimea	Hanapepe	20304	22.35	127	41	40	46	50	26	10	3	1
		Total:	197.73					214	110			
		Total:	547.59					749	388			

WELL CAPACITIES AND WATER USE

SUMMARIES

PROJECT: Kauai Water Study
JOB NO: 1-15409-0-E
ITEM: WELL CAPACITIES PER MUNICIPAL SYSTEM
FILE: Wells.dbf
LAST UPDATE: July 31, 1989

Table A-13

NAME	MUN_SYSTEM	SYSTEM	CAP_GPM	STATUS	FUTURE	FUTR	STAND	STBY	C
ANAHOLA (STANDBY)	ANAHOLA	104	400.00	S	400.00	GPM	400.00	GPM	1
ANAHOLA A	ANAHOLA	104	250.00	0					1
ANAHOLA B	ANAHOLA	104	250.00	0					1
MAKA RIDGE	HANALEI	202	250.00	0					2
HANAPEPE A	HANAPEPE	304	500.00	0					3
HANAPEPE B	HANAPEPE	304	700.00	0					3
HANAPEPE-NAGOSHI	HANAPEPE	304	360.00	0					3
MCBRYDE SUGAR (STBY)	HANAPEPE	304	24600.00	S	24600.00	GPM	24600.00	GPM	3
KILAUEA 1	KALIHIWAI	105	700.00	0					4
KILAUEA 2	KALIHIWAI	105	700.00	S					4
KEKAHA 1 - PAUA	KEKAHA	301	500.00	0					5
KEKAHA 2 - WAIPAO	KEKAHA	301	700.00	0					5
KEKAHA SHAFT	KEKAHA	301	225.00	S					5
WAIMEA A	KEKAHA	301	200.00	0					5
WAIMEA B	KEKAHA	301	210.00	0					5
WAIMEA SHAFT 9	KEKAHA	302	300.00	0					5
ALEXANDER DAM	KOLOA	101	350.00	0					6
KALAHEO A	KOLOA	101	900.00	0					6
KALAHEO B	KOLOA	101	1100.00	S					6
KOLOA 16-A	KOLOA	101	1200.00	0					6
KOLOA 16-B	KOLOA	101	560.00	0					6
KOLOA C- MAHAULEPU 1	KOLOA	101	1200.00	0					6
KOLOA D- MAHAULEPU 2	KOLOA	101	1200.00	0					6
LAWAI 1	KOLOA	101	420.00	0					6
GARLINGHOUSE TUNNEL	LIHUE	102	850.00	0					7
KCC WELL	LIHUE	102	200.00	0					7
KILOHANA A	LIHUE	102	420.00	0					7
KILOHANA B	LIHUE	102	700.00	S					7
KILOHANA C	LIHUE	102	250.00	0					7
KILOHANA E	LIHUE	102	300.00	0					7
KILOHANA F	LIHUE	102	400.00	0					7
KILOHANA G	LIHUE	102	200.00	0					7
KILOHANA I	LIHUE	102	700.00	0					7
KOKOLAU TUNNEL	LIHUE	102	450.00	0					7
LIHUE SCHOOL	LIHUE	102	150.00	0					7
PUHI TUNNEL	LIHUE	102	200.00	0					7
AKULIKULI TUNNEL	WAILUA	104	500.00	0					8
MAKALEHA A	WAILUA	104	1000.00	F					8
MAKALEHA TUNNEL	WAILUA	104	500.00	0					8
MOELEPE	WAILUA	104	350.00	0					8
NONOU A	WAILUA	103	450.00	0					8
NONOU B	WAILUA	103	1000.00	0					8
NONOU C	WAILUA	103	1000.00	0					8
WAILUA HMSTDS A	WAILUA	103	500.00	0					8
WAILUA HMSTDS B	WAILUA	103	500.00	S					8
HAENA	WAINIHA	203	100.00	0					9
WAINIHA 1	WAINIHA	203	50.00	0					9
WAINIHA 2	WAINIHA	203	210.00	F					9

TOTALS:

ANAHOLA	0.72 MGD	0.00 FUTR	0.58 STBY	
HANALEI	0.36 MGD	0.00 FUTR	0.00 STBY	
HANAPEPE	2.25 MGD	0.00 FUTR	35.42 STBY	
KALIHIWAI	1.01 MGD	0.00 FUTR	1.01 STBY	
KEKAHA	2.75 MGD	0.00 FUTR	0.32 STBY	
KOLOA	8.40 MGD	0.00 FUTR	1.58 STBY	
LIHUE	5.93 MGD	0.00 FUTR	1.01 STBY	
WAILUA	6.19 MGD	1.44 FUTR	0.72 STBY	
WAINIHA	0.22 MGD	0.30 FUTR	0.00 STBY	
TOTAL:	27.82 MGD	1.74 MGD	40.64 MGD	
check	27.83 MGD	1.74 MGD	40.64 MGD	

Table A-14

HAWAII WATER PLAN
STATE WATER PROJECTS PLAN
LISTING OF STATE PROJECTS BY HYDROLOGIC UNIT

HYDROLOGIC SYSTEM	CODE	DEPARTMENT	PROJECT NAME	ULTIMATE DEMAND (MGD)
** ISLAND OF KAUAI				
* HYDROLOGIC SECTOR LIHUE				
KOLOA	20101	BUDGET & FINANCE	WELIWELI PROJECT	0.20
KOLOA	20101	TRANSPORTATION	PORT ALLEN HARBOR - 2010 MASTER PLAN	0.02
HANAMAULU	20102	BUDGET & FINANCE	PUHI	0.01
HANAMAULU	20102	BUDGET & FINANCE	KAUAI RENTAL	0.05
HANAMAULU	20102	BUDGET & FINANCE	AMFAC PARCEL - HANAMAULU	0.21
HANAMAULU	20102	BUDGET & FINANCE	KAUAI ELDERLY	0.03
HANAMAULU	20102	BUDGET & FINANCE	ARC OF HAWAII - PROJECT #10 (LIHUE)	0.00
HANAMAULU	20102	EDUCATION	HANAMAULU/WAILUA ELEMENTARY SCHOOL	0.06
HANAMAULU	20102	TRANSPORTATION	AHUKINI RD & KAPULE HWY LANDSCAPING	0.00
HANAMAULU	20102	BUDGET & FINANCE	MOLOKOA PROJECT	0.59
HANAMAULU	20102	TRANSPORTATION	NAWILIWILI HARBOR - 2010 MASTER PLAN	0.10
HANAMAULU	20102	TRANSPORTATION	LIHUE AIRPORT MASTER PLAN	0.72
WAILUA	20103	BUDGET & FINANCE	WAILUA MAUKA	0.96
WAILUA	20103	BUDGET & FINANCE	WAILUA MAKAI	0.13
WAILUA	20103	AGRICULTURE	WAILUA AGRICULTURAL PARK	1.00
ANAHOLA	20104	HAWAIIAN HOME LANDS	MOLOAA - PASTURE LOTS	0.00
ANAHOLA	20104	HAWAIIAN HOME LANDS	ANAHOLA - RESIDENCE LOTS UNIT3	0.02
ANAHOLA	20104	HAWAIIAN HOME LANDS	MOLOAA - FARM LOTS	0.01
ANAHOLA	20104	HAWAIIAN HOME LANDS	ANAHOLA - RESIDENCE LOTS UNIT 4	0.04
ANAHOLA	20104	HAWAIIAN HOME LANDS	ANAHOLA - RESIDENCE LOTS UNIT 5	0.02
ANAHOLA	20104	HAWAIIAN HOME LANDS	ANAHOLA - RESIDENCE LOTS J & K	0.01
ANAHOLA	20104	HAWAIIAN HOME LANDS	ANAHOLA - RESIDENCE LOTS (VILLAGE)	0.01
ANAHOLA	20104	HAWAIIAN HOME LANDS	ANAHOLA - RESIDENCE LOTS BAYVIEW	0.03
ANAHOLA	20104	HAWAIIAN HOME LANDS	ANAHOLA - RESIDENCE LOTS M	0.02
ANAHOLA	20104	HAWAIIAN HOME LANDS	ANAHOLA - FARM LOTS UNIT 1A INCREMENT 2	0.00
ANAHOLA	20104	EDUCATION	KAPAA INTERMEDIATE SCHOOL	0.09
ANAHOLA	20104	EDUCATION	KAPAA II ELEMENTARY SCHOOL	0.06
ANAHOLA	20104	AGRICULTURE	MOLOAA AGRICULTURAL PARK	3.80
* Subsubtotal *				8.19
* HYDROLOGIC SECTOR WAIMEA				
KEKAHA	20301	HAWAIIAN HOME LANDS	KEKAHA - RESIDENCE LOTS UNIT2	0.01
MAKAWELI	20303	BUDGET & FINANCE	HANAPEPE STATE LAND - HANAPEPE HEIGHTS	0.26
* Subsubtotal *				0.27
** Subtotal **				8.46

Table A-15

Kauai Water Study Job Number: 1-15409-0-E
EXISTING WATER USE SUMMARY
Includes all Muicipal and Irrigation Water Usage
Categorized as follows:
D -> Municipal (Used and Withdrawn)
M -> Municipal (Withdrawn Only)
N -> Municipal (Used Only)
I -> Irrigation (Used and Withdrawn)
W -> Irrigation (Withdrawn Only)
U -> Irrigation (Used Only)
E -> High Level (Withdrawn Only)
C -> High Level (Used Only)
(Letter Code appears in K field in database.)

Program Title: Total_KW.prg
Results Written to: Results.dbf
Active Database: KAUAI-W.dbf
Last Edit: Aug. 08, 1989

		USED	WITHDRAWN
System:	101		
Wells (Irrigation)		26.02 MGD	10.34 MGD
Surface (Irrig.)		28.52 MGD	12.03 MGD
TOTAL IRRIGATION		54.54 MGD	22.37 MGD
Wells (Municipal)		5.91 MGD	5.91 MGD
Surface (Munic.)		0.50 MGD	0.50 MGD
H. Level (Munic.)		0.00 MGD	0.00 MGD
TOTAL MUNICIPAL		6.41 MGD	6.41 MGD
System:	102		
Wells (Irrigation)		1.52 MGD	1.52 MGD
Surface (Irrig.)		26.08 MGD	7.22 MGD
TOTAL IRRIGATION		27.59 MGD	8.74 MGD
Wells (Municipal)		1.01 MGD	1.01 MGD
Surface (Munic.)		0.00 MGD	0.00 MGD
H. Level (Munic.)		1.83 MGD	1.83 MGD
TOTAL MUNICIPAL		2.83 MGD	2.83 MGD
System:	103		
Wells (Irrigation)		0.00 MGD	0.00 MGD
Surface (Irrig.)		43.61 MGD	60.52 MGD
TOTAL IRRIGATION		43.61 MGD	60.52 MGD
Wells (Municipal)		0.33 MGD	0.33 MGD
Surface (Munic.)		0.00 MGD	0.00 MGD
H. Level (Munic.)		0.21 MGD	0.00 MGD
TOTAL MUNICIPAL		0.54 MGD	0.33 MGD
System:	104		
Wells (Irrigation)		0.85 MGD	0.85 MGD
Surface (Irrig.)		35.91 MGD	25.63 MGD
TOTAL IRRIGATION		36.76 MGD	26.47 MGD
Wells (Municipal)		0.14 MGD	0.14 MGD
Surface (Munic.)		0.00 MGD	0.00 MGD
H. Level (Munic.)		1.56 MGD	1.77 MGD
TOTAL MUNICIPAL		1.69 MGD	1.91 MGD
System:	105		
Wells (Irrigation)		0.00 MGD	0.00 MGD
Surface (Irrig.)		6.89 MGD	6.89 MGD
TOTAL IRRIGATION		6.89 MGD	6.89 MGD
Wells (Municipal)		0.19 MGD	0.28 MGD
Surface (Munic.)		0.00 MGD	0.00 MGD
H. Level (Munic.)		0.00 MGD	0.00 MGD
TOTAL MUNICIPAL		0.19 MGD	0.28 MGD

System:	201		
Wells (Irrigation)	0.00 MGD	0.00 MGD	
Surface (Irrig.)	0.11 MGD	0.11 MGD	
TOTAL IRRIGATION	0.11 MGD	0.11 MGD	
Wells (Municipal)	0.61 MGD	0.79 MGD	
Surface (Munic.)	0.00 MGD	0.00 MGD	
H. Level (Munic.)	0.00 MGD	0.00 MGD	
TOTAL MUNICIPAL	0.61 MGD	0.79 MGD	
System:	202		
Wells (Irrigation)	0.00 MGD	0.00 MGD	
Surface (Irrig.)	13.15 MGD	30.61 MGD	
TOTAL IRRIGATION	13.15 MGD	30.61 MGD	
Wells (Municipal)	0.37 MGD	0.11 MGD	
Surface (Munic.)	0.00 MGD	0.00 MGD	
H. Level (Munic.)	0.00 MGD	0.00 MGD	
TOTAL MUNICIPAL	0.37 MGD	0.11 MGD	
System:	203		
Wells (Irrigation)	0.00 MGD	0.00 MGD	
Surface (Irrig.)	8.29 MGD	8.29 MGD	
TOTAL IRRIGATION	8.29 MGD	8.29 MGD	
Wells (Municipal)	0.09 MGD	0.09 MGD	
Surface (Munic.)	53.89 MGD	53.89 MGD	
H. Level (Munic.)	0.00 MGD	0.00 MGD	
TOTAL MUNICIPAL	53.98 MGD	53.98 MGD	
System:	204		
Wells (Irrigation)	0.00 MGD	0.00 MGD	
Surface (Irrig.)	0.00 MGD	0.00 MGD	
TOTAL IRRIGATION	0.00 MGD	0.00 MGD	
Wells (Municipal)	0.00 MGD	0.00 MGD	
Surface (Munic.)	0.00 MGD	0.00 MGD	
H. Level (Munic.)	0.00 MGD	0.00 MGD	
TOTAL MUNICIPAL	0.00 MGD	0.00 MGD	
System:	301		
Wells (Irrigation)	19.17 MGD	19.17 MGD	
Surface (Irrig.)	52.53 MGD	0.53 MGD	
TOTAL IRRIGATION	71.70 MGD	19.70 MGD	
Wells (Municipal)	0.90 MGD	0.35 MGD	
Surface (Munic.)	0.00 MGD	0.00 MGD	
H. Level (Munic.)	0.00 MGD	0.00 MGD	
TOTAL MUNICIPAL	0.90 MGD	0.35 MGD	
System:	302		
Wells (Irrigation)	0.00 MGD	0.00 MGD	
Surface (Irrig.)	5.78 MGD	57.78 MGD	
TOTAL IRRIGATION	5.78 MGD	57.78 MGD	
Wells (Municipal)	0.28 MGD	0.83 MGD	
Surface (Munic.)	0.00 MGD	0.00 MGD	
H. Level (Munic.)	0.00 MGD	0.00 MGD	
TOTAL MUNICIPAL	0.28 MGD	0.83 MGD	
System:	303		
Wells (Irrigation)	2.15 MGD	2.15 MGD	
Surface (Irrig.)	77.58 MGD	51.58 MGD	
TOTAL IRRIGATION	79.72 MGD	53.72 MGD	
Wells (Municipal)	0.26 MGD	0.26 MGD	
Surface (Munic.)	0.00 MGD	0.00 MGD	
H. Level (Munic.)	0.00 MGD	0.00 MGD	
TOTAL MUNICIPAL	0.26 MGD	0.26 MGD	

Table A-16

ITEM	SYSTEM	USED	USED_LABEL	WITHDRAWN	WITH_LABEL
Program: 20YRTOT.PRG					
File: 20-YEAR.DBF					
Dbase: RESULTS.DBF					
Feb. 1, 1990 11:00am					
**New state wells added manually.		USE		WDR	
System:	101	0.00		0.00	
Wells (Irrigation)	0	26.02	MGD	10.34	MGD
Surface (Irrig.)	0	28.52	MGD	12.03	MGD
TOTAL IRRIGATION	0	54.54	MGD	22.37	MGD
Wells (Municipal)	0	4.89	MGD	4.89	MGD
Surface (Munic.)	0	0.50	MGD	0.50	MGD
TOTAL MUNICIPAL	0	5.39	MGD	5.39	MGD
	0	0.00		0.00	
System:	102	0.00		0.00	
Wells (Irrigation)	0	1.52	MGD	1.52	MGD
Surface (Irrig.)	0	26.08	MGD	7.22	MGD
TOTAL IRRIGATION	0	27.59	MGD	8.74	MGD
Wells (Municipal)	0	6.03	MGD	6.03	MGD
Surface (Munic.)	0	0.00	MGD	0.00	MGD
TOTAL MUNICIPAL	0	6.03	MGD	6.03	MGD
	0	0.00		0.00	
System:	103	0.00		0.00	
Wells (Irrigation)	0	1.00	MGD	1.00	MGD
Surface (Irrig.)	0	43.61	MGD	60.52	MGD
TOTAL IRRIGATION	0	44.61	MGD	61.52	MGD
Wells (Municipal)	0	0.85	MGD	0.85	MGD
Surface (Munic.)	0	0.00	MGD	0.00	MGD
TOTAL MUNICIPAL	0	0.85	MGD	0.85	MGD
	0	0.00		0.00	
System:	104	0.00		0.00	
Wells (Irrigation)	0	4.65	MGD	4.65	MGD
Surface (Irrig.)	0	35.91	MGD	25.63	MGD
TOTAL IRRIGATION	0	36.76	MGD	30.28	MGD
Wells (Municipal)	0	2.95	MGD	2.95	MGD
Surface (Munic.)	0	0.00	MGD	0.00	MGD
TOTAL MUNICIPAL	0	2.95	MGD	2.95	MGD
	0	0.00		0.00	
System:	105	0.00		0.00	
Wells (Irrigation)	0	0.00	MGD	0.00	MGD
Surface (Irrig.)	0	6.89	MGD	6.89	MGD
TOTAL IRRIGATION	0	6.89	MGD	6.89	MGD
Wells (Municipal)	0	0.41	MGD	0.50	MGD
Surface (Munic.)	0	0.00	MGD	0.00	MGD
TOTAL MUNICIPAL	0	0.41	MGD	0.50	MGD
	0	0.00		0.00	
System:	201	0.00		0.00	
Wells (Irrigation)	0	0.00	MGD	0.00	MGD
Surface (Irrig.)	0	0.11	MGD	0.11	MGD
TOTAL IRRIGATION	0	0.11	MGD	0.11	MGD
Wells (Municipal)	0	1.27	MGD	1.45	MGD
Surface (Munic.)	0	0.00	MGD	0.00	MGD
TOTAL MUNICIPAL	0	1.27	MGD	1.45	MGD
	0	0.00		0.00	
System:	202	0.00		0.00	
Wells (Irrigation)	0	0.00	MGD	0.00	MGD
Surface (Irrig.)	0	13.15	MGD	30.61	MGD

System:	304			
Wells (Irrigation)	0.00	MGD	15.68	MGD
Surface (Irrig.)	7.02	MGD	44.28	MGD
TOTAL IRRIGATION	7.02	MGD	59.97	MGD
Wells (Municipal)	0.15	MGD	0.15	MGD
Surface (Munic.)	0.00	MGD	0.00	MGD
H. Level (Munic.)	0.00	MGD	0.00	MGD
TOTAL MUNICIPAL	0.15	MGD	0.15	MGD

TOTALS!		
Used for Irrig.	355.2	MGD
Withdrawn for Irr.	355.2	MGD
Used for Munic.	68.21	MGD
Withdrawn for Mun.	68.23	MGD
Wells Used	59.95	MGD
Wells Withdrawn	59.96	MGD
TOTAL USED	423.4	
TOTAL WITHDRAWN	423.4	MGD

TOTAL IRRIGATION	0	13.15	MGD	30.61 MGD
Wells (Municipal)	0	1.18	MGD	0.92 MGD
Surface (Munic.)	0	0.00	MGD	0.00 MGD
TOTAL MUNICIPAL	0	1.18	MGD	0.92 MGD
	0	0.00		0.00
System:	203	0.00		0.00
Wells (Irrigation)	0	0.00	MGD	0.00 MGD
Surface (Irrig.)	0	8.29	MGD	8.29 MGD
TOTAL IRRIGATION	0	8.29	MGD	8.29 MGD
Wells (Municipal)	0	0.25	MGD	0.25 MGD
Surface (Munic.)	0	53.89	MGD	53.89 MGD
TOTAL MUNICIPAL	0	54.14	MGD	54.14 MGD
	0	0.00		0.00
System:	204	0.00		0.00
Wells (Irrigation)	0	0.00	MGD	0.00 MGD
Surface (Irrig.)	0	0.00	MGD	0.00 MGD
TOTAL IRRIGATION	0	0.00	MGD	0.00 MGD
Wells (Municipal)	0	0.00	MGD	0.00 MGD
Surface (Munic.)	0	0.00	MGD	0.00 MGD
TOTAL MUNICIPAL	0	0.00	MGD	0.00 MGD
	0	0.00		0.00
System:	301	0.00		0.00
Wells (Irrigation)	0	19.17	MGD	19.17 MGD
Surface (Irrig.)	0	52.53	MGD	0.53 MGD
TOTAL IRRIGATION	0	71.70	MGD	19.70 MGD
Wells (Municipal)	0	1.14	MGD	0.59 MGD
Surface (Munic.)	0	0.00	MGD	0.00 MGD
TOTAL MUNICIPAL	0	1.14	MGD	0.59 MGD
	0	0.00		0.00
System:	302	0.00		0.00
Wells (Irrigation)	0	0.00	MGD	0.00 MGD
Surface (Irrig.)	0	5.78	MGD	57.78 MGD
TOTAL IRRIGATION	0	5.78	MGD	57.78 MGD
Wells (Municipal)	0	0.20	MGD	0.75 MGD
Surface (Munic.)	0	0.00	MGD	0.00 MGD
TOTAL MUNICIPAL	0	0.20	MGD	0.75 MGD
	0	0.00		0.00
System:	303	0.00		0.00
Wells (Irrigation)	0	2.15	MGD	2.15 MGD
Surface (Irrig.)	0	77.58	MGD	51.58 MGD
TOTAL IRRIGATION	0	79.72	MGD	53.72 MGD
Wells (Municipal)	0	0.33	MGD	0.33 MGD
Surface (Munic.)	0	0.00	MGD	0.00 MGD
TOTAL MUNICIPAL	0	0.33	MGD	0.33 MGD
	0	0.00		0.00
System:	304	0.00		0.00
Wells (Irrigation)	0	0.00	MGD	15.68 MGD
Surface (Irrig.)	0	7.02	MGD	44.28 MGD
TOTAL IRRIGATION	0	7.02	MGD	59.97 MGD
Wells (Municipal)	0	0.10	MGD	0.10 MGD
Surface (Munic.)	0	0.00	MGD	0.00 MGD
TOTAL MUNICIPAL	0	0.10	MGD	0.10 MGD
	0	0.00		0.00
	0	0.00		0.00
TOTALS!	0	0.00		0.00
Used for Irrig.	0	355.2	MGD	0.00
Withdrawn for Irr.	0	355.2	MGD	0.00
Used for Munic.	0	73.99	MGD	0.00
Withdrawn for Mun.	0	74.00	MGD	0.00
Wells Used	0	69.31	MGD	0.00

Wells Withdrawn	0	69.32 MGD	0.00
	0	0.00	0.00
TOTAL USED	0	429.1	0.00
TOTAL WITHDRAWN	0	429.2 MGD	0.00
	0	0.00	0.00

Table A-17

ITEM	SYSTEM	USED	USED_LABEL	WITHDRAWN	WITH_LABEL
Program: ULTOTAL.PRG					
File: ULTIMATE.DBF					
Dbase: RESULTS.DBF					
Feb. 16, 1990 4:00pm					
**New state wells added manually.					
		USE		WDR	
System:	101	0.00		0.00	
Wells (Irrigation)	0	26.02	MGD	10.34	MGD
Surface (Irrig.)	0	28.52	MGD	12.03	MGD
TOTAL IRRIGATION	0	54.54	MGD	22.37	MGD
Wells (Municipal)	0	10.18	MGD	10.18	MGD
Surface (Munic.)	0	0.50	MGD	0.50	MGD
TOTAL MUNICIPAL	0	10.68	MGD	10.68	MGD
	0	0.00		0.00	
System:	102	0.00		0.00	
Wells (Irrigation)	0	1.52	MGD	1.52	MGD
Surface (Irrig.)	0	26.08	MGD	7.22	MGD
TOTAL IRRIGATION	0	27.59	MGD	8.74	MGD
Wells (Municipal)	0	8.74	MGD	8.74	MGD
Surface (Munic.)	0	0.00	MGD	0.00	MGD
TOTAL MUNICIPAL	0	8.74	MGD	8.74	MGD
	0	0.00		0.00	
System:	103	0.00		0.00	
Wells (Irrigation)	0	1.00	MGD	1.00	MGD
Surface (Irrig.)	0	43.61	MGD	60.52	MGD
TOTAL IRRIGATION	0	44.61	MGD	61.52	MGD
Wells (Municipal)	0	1.25	MGD	1.25	MGD
Surface (Munic.)	0	0.00	MGD	0.00	MGD
TOTAL MUNICIPAL	0	1.25	MGD	1.25	MGD
	0	0.00		0.00	
System:	104	0.00		0.00	
Wells (Irrigation)	0	4.65	MGD	4.65	MGD
Surface (Irrig.)	0	35.91	MGD	25.63	MGD
TOTAL IRRIGATION	0	40.56	MGD	30.28	MGD
Wells (Municipal)	0	4.55	MGD	4.55	MGD
Surface (Munic.)	0	0.00	MGD	0.00	MGD
TOTAL MUNICIPAL	0	4.55	MGD	4.55	MGD
	0	0.00		0.00	
System:	105	0.00		0.00	
Wells (Irrigation)	0	0.00	MGD	0.00	MGD
Surface (Irrig.)	0	6.89	MGD	6.89	MGD
TOTAL IRRIGATION	0	6.89	MGD	6.89	MGD
Wells (Municipal)	0	0.73	MGD	0.82	MGD
Surface (Munic.)	0	0.00	MGD	0.00	MGD
TOTAL MUNICIPAL	0	0.73	MGD	0.82	MGD
	0	0.00		0.00	
System:	201	0.00		0.00	
Wells (Irrigation)	0	0.00	MGD	0.00	MGD
Surface (Irrig.)	0	0.11	MGD	0.11	MGD
TOTAL IRRIGATION	0	0.11	MGD	0.11	MGD
Wells (Municipal)	0	2.29	MGD	2.47	MGD
Surface (Munic.)	0	0.00	MGD	0.00	MGD
TOTAL MUNICIPAL	0	2.29	MGD	2.47	MGD
	0	0.00		0.00	
System:	202	0.00		0.00	
Wells (Irrigation)	0	0.00	MGD	0.00	MGD
Surface (Irrig.)	0	13.15	MGD	30.61	MGD
TOTAL IRRIGATION	0	13.15	MGD	30.61	MGD
Wells (Municipal)	0	2.14	MGD	1.88	MGD
Surface (Munic.)	0	0.00	MGD	0.00	MGD
TOTAL MUNICIPAL	0	2.14	MGD	1.88	MGD
	0	0.00		0.00	
System:	203	0.00		0.00	

Wells (Irrigation)	0	0.00	MGD	0.00 MGD
Surface (Irrig.)	0	8.29	MGD	8.29 MGD
TOTAL IRRIGATION	0	8.29	MGD	8.29 MGD
Wells (Municipal)	0	0.45	MGD	0.45 MGD
Surface (Munic.)	0	53.89	MGD	53.89 MGD
TOTAL MUNICIPAL	0	54.34	MGD	54.34 MGD
	0	0.00		0.00
System:	204	0.00		0.00
Wells (Irrigation)	0	0.00	MGD	0.00 MGD
Surface (Irrig.)	0	0.00	MGD	0.00 MGD
TOTAL IRRIGATION	0	0.00	MGD	0.00 MGD
Wells (Municipal)	0	0.00	MGD	0.00 MGD
Surface (Munic.)	0	0.00	MGD	0.00 MGD
TOTAL MUNICIPAL	0	0.00	MGD	0.00 MGD
	0	0.00		0.00
System:	301	0.00		0.00
Wells (Irrigation)	0	19.17	MGD	19.17 MGD
Surface (Irrig.)	0	52.53	MGD	0.53 MGD
TOTAL IRRIGATION	0	71.70	MGD	19.70 MGD
Wells (Municipal)	0	2.77	MGD	2.22 MGD
Surface (Munic.)	0	0.00	MGD	0.00 MGD
TOTAL MUNICIPAL	0	2.77	MGD	2.22 MGD
	0	0.00		0.00
System:	302	0.00		0.00
Wells (Irrigation)	0	0.00	MGD	0.00 MGD
Surface (Irrig.)	0	5.78	MGD	57.78 MGD
TOTAL IRRIGATION	0	5.78	MGD	57.78 MGD
Wells (Municipal)	0	0.49	MGD	1.04 MGD
Surface (Munic.)	0	0.00	MGD	0.00 MGD
TOTAL MUNICIPAL	0	0.49	MGD	1.04 MGD
	0	0.00		0.00
System:	303	0.00		0.00
Wells (Irrigation)	0	2.15	MGD	2.15 MGD
Surface (Irrig.)	0	77.58	MGD	51.58 MGD
TOTAL IRRIGATION	0	79.72	MGD	53.72 MGD
Wells (Municipal)	0	0.81	MGD	0.81 MGD
Surface (Munic.)	0	0.00	MGD	0.00 MGD
TOTAL MUNICIPAL	0	0.81	MGD	0.81 MGD
	0	0.00		0.00
System:	304	0.00		0.00
Wells (Irrigation)	0	0.00	MGD	15.68 MGD
Surface (Irrig.)	0	7.02	MGD	44.28 MGD
TOTAL IRRIGATION	0	7.02	MGD	59.97 MGD
Wells (Municipal)	0	0.25	MGD	0.25 MGD
Surface (Munic.)	0	0.00	MGD	0.00 MGD
TOTAL MUNICIPAL	0	0.25	MGD	0.25 MGD
	0	0.00		0.00
	0	0.00		0.00
TOTALS!	0	0.00		0.00
Used for Irrig.	0	355.2	MGD	0.00
Withdrawn for Irr.	0	355.2	MGD	0.00
Used for Munic.	0	89.04	MGD	0.00
Withdrawn for Mun.	0	89.05	MGD	0.00
Wells Used	0	84.36	MGD	0.00
Wells Withdrawn	0	84.37	MGD	0.00
	0	0.00		0.00
TOTAL USED	0	444.2		0.00
TOTAL WITHDRAWN	0	444.2	MGD	0.00
	0	0.00		0.00

Table A-18

PROJECT: KAUAI WATER STUDY
JOB NO. 1-154090-0-E
ITEM: EXISTING WATER USE

JULY 25, 1989
11:00 AM

DESCRIPTION: This database includes all municipal, as well as irrigational, water usage categorized by either surface water or groundwater. The K field is described as follows:

D = municipal (domestic)
M = municipal withdrawn only
N = municipal used only
W = irrigation withdrawn only
U = irrigation used only
I = irrigation used & withdrawn
C = high level ground water used only
E = high level ground water withdrawn only.

The TYPE field describes surface water, high-level groundwater, and deep well water by an S, H, and W, respectively.

NAME	TMK	SYSTEM	TYPE	ID_NO	CAP_GPM	USE1000GPD	DAYS	ACREAGE	K
*MUNICIPAL	1304	101	W			82.21	365		D
*MUNICIPAL	1306	101	W			0.00	365		D
*MUNICIPAL	1307	101	S			237.90	365		D
*MUNICIPAL	2101	101	W			33.90	365		D
*MUNICIPAL	2102	101	S			104.62	365		D
*MUNICIPAL	2103	101	W			11.23	365		D
*MUNICIPAL	2104	101	W			197.16	365		D
*MUNICIPAL	2105	101	W			99.01	365		D
*MUNICIPAL	2106	101	W			18.57	365		D
*MUNICIPAL	2201	101	S			65.59	365		D
*MUNICIPAL	2202	101	S			95.86	365		D
*MUNICIPAL	2203	101	W			14.82	365		D
*MUNICIPAL	2204	101	W			116.48	365		D
*MUNICIPAL	2231	101	W			10.57	365		D
*MUNICIPAL	2301	101	W			4.13	365		D
*MUNICIPAL	2302	101	W			87.25	365		D
*MUNICIPAL	2303	101	W			65.26	365		D
*MUNICIPAL	2304	101	W			121.10	365		D
*MUNICIPAL	2401	101	W			177.42	365		D
*MUNICIPAL	2402	101	W			5.90	365		D
*MUNICIPAL	2403	101	W			96.74	365		D
*MUNICIPAL	2404	101	W			712.83	365		D
*MUNICIPAL	2405	101	W			455.88	365		D
*MUNICIPAL	3101	102	W			152.94	365		D
*MUNICIPAL	3102	102	W			34.67	365		D
*MUNICIPAL	3201	102	W			23.98	365		D
*MUNICIPAL	3202	102	W			65.35	365		D
*MUNICIPAL	3203	102	W			81.24	365		D
*MUNICIPAL	3204	102	W			115.16	365		D
*MUNICIPAL	3205	102	H			575.64	365		D
*MUNICIPAL	3206	102	W			82.56	365		D
*MUNICIPAL	3207	102	W			160.80	365		D
*MUNICIPAL	3208	102	W			80.47	365		D
*MUNICIPAL	3209	102	H			261.08	365		D
*MUNICIPAL	3210	102	H			215.18	365		D
*MUNICIPAL	3211	102	W			141.68	365		D
*MUNICIPAL	3212	102	W			69.12	365		D

*MUNICIPAL	3213	102 H	19.96	365	D
*MUNICIPAL	3214	102 H	168.58	365	D
*MUNICIPAL	3215	102 H	179.65	365	D
*MUNICIPAL	3216	102 H	27.76	365	D
*MUNICIPAL	4101	102 H	383.96	365	D
*MUNICIPAL	4102	103 H	213.70	365	C
*MUNICIPAL	4103	103 W	42.30	365	D
*MUNICIPAL	4104	103 W	0.00	365	D
*MUNICIPAL	4113	103 W	58.38	365	D
*MUNICIPAL	4114	103 W	74.25	365	D
*MUNICIPAL	4115	103 W	119.21	365	D
*MUNICIPAL	4116	103 W	35.41	365	D
*MUNICIPAL	4102	104 H	334.25	365	D
*MUNICIPAL	4102	104 H	213.70	365	E
*MUNICIPAL	4103	104 H	120.38	365	D
*MUNICIPAL	4104	104 H	0.00	365	D
*MUNICIPAL	4105	104 H	132.82	365	D
*MUNICIPAL	4106	104 H	214.94	365	D
*MUNICIPAL	4107	104 H	50.68	365	D
*MUNICIPAL	4108	104 H	324.94	365	D
*MUNICIPAL	4109	104 H	200.43	365	D
*MUNICIPAL	4110	104 H	24.97	365	D
*MUNICIPAL	4111	104 H	66.76	365	D
*MUNICIPAL	4112	104 H	29.95	365	D
*MUNICIPAL	4113	104 H	58.38	365	D
*MUNICIPAL	4201	104 W	65.52	365	D
*MUNICIPAL	4202	104 W	50.02	365	D
*MUNICIPAL	4203	104 W	0.00	365	D
*MUNICIPAL	4204	104 W	5.55	365	D
*MUNICIPAL	4205	104 W	11.55	365	D
*MUNICIPAL	4206	104 W	2.38	365	D
*MUNICIPAL	4301	104 W	0.90	365	D
*MUNICIPAL	5101	105 W	19.52	365	D
*MUNICIPAL	5102	105 W	10.39	365	D
*MUNICIPAL	5103	105 W	8.29	365	D
*MUNICIPAL	5103	105 W	18.46	365	M
*MUNICIPAL	5104	105 W	138.35	365	D
*MUNICIPAL	5104	105 W	24.42	365	M
*MUNICIPAL	5105	105 W	16.40	365	D
*MUNICIPAL	5105	105 W	16.41	365	M
*MUNICIPAL	5107	105 W	26.03	365	M
*MUNICIPAL	5103	201 W	18.46	365	N
*MUNICIPAL	5104	201 W	24.42	365	N
*MUNICIPAL	5105	201 W	16.41	365	N
*MUNICIPAL	5106	201 W	0.00	365	D
*MUNICIPAL	5107	201 W	26.03	365	N
*MUNICIPAL	5201	201 W	14.87	365	D
*MUNICIPAL	5501	201 W	0.00	365	D
*MUNICIPAL	5301	202 W	106.12	365	D
*MUNICIPAL	5501	202 W	0.00	365	D
*MUNICIPAL	5401	203 W	20.15	365	D
*MUNICIPAL	5402	203 W	68.63	365	D
*MUNICIPAL	5420	203 W	0.15	365	D
*MUNICIPAL	0000	204 W	0.00	365	D
*MUNICIPAL	1101	301 W	0.00	365	D
*MUNICIPAL	1102	301 W	108.72	365	D
*MUNICIPAL	1103	301 W	205.00	365	N
*MUNICIPAL	1104	301 W	192.60	365	N
*MUNICIPAL	1105	301 W	0.00	365	D
*MUNICIPAL	1106	301 W	154.24	365	N

*MUNICIPAL	1201	301	W			56.04	365		D
*MUNICIPAL	1202	301	W			0.00	365		D
*MUNICIPAL	1203	301	W			0.00	365		D
*MUNICIPAL	1204	301	W			95.53	365		D
*MUNICIPAL	1205	301	W			60.18	365		D
*MUNICIPAL	1206	301	W			0.00	365		D
*MUNICIPAL	1207	301	W			28.90	365		D
*MUNICIPAL	1103	302	W			205.00	365		M
*MUNICIPAL	1104	302	W			192.60	365		M
*MUNICIPAL	1106	302	W			154.24	365		M
*MUNICIPAL	1205	302	W			7.06	365		D
*MUNICIPAL	1206	302	W			7.85	365		D
*MUNICIPAL	1207	302	W			163.75	365		D
*MUNICIPAL	1208	302	W			96.80	365		D
*MUNICIPAL	1301	303	W			0.00	365		D
*MUNICIPAL	1302	303	W			48.75	365		D
*MUNICIPAL	1303	303	W			0.00	365		D
*MUNICIPAL	1304	303	W			0.00	365		D
*MUNICIPAL	1305	303	W			0.00	365		D
*MUNICIPAL	1302	304	W			18.03	365		D
*MUNICIPAL	1303	304	W			24.20	365		D
*MUNICIPAL	1304	304	W			78.98	365		D
*MUNICIPAL	1305	304	W			31.47	365		D
AANA JK	1-7-2:3	303	S		4486	0.00	0	0.0	I
ACHI SH	3-2-1:2	102	S		50	72.00	365	2.4	I
ACHI SH	3-2-2:2	102	S		100	144.00	365	0.0	I
ANDERSON G	5-4-3:1	202	S		3264	0.00	365	8.8	I
AZEKA H	5-6-4:7	202	S		4143	0.00	365	5.0	I
BARNARD BJI	5-1-5:36	105	W	1123-01	8	3.00	365	0.0	I
BEAN R	4-9-11:19R	104	S		20	0.99	365	2.7	I
BENDER J	4-6-14:16	104	P		1200	568.11	365	9.7	I
BOISER DP		104	S		15	5.75	365	0.5	I
BRODIE L	5-3-8:11	201	S		25	2.19	365	50.0	I
BROWN HD	4-4-12:9	104	S		60	0.00	365	5.8	I
CAMARA JA	2-6-1:101	101	S		0	0.00	365	45.0	K
CAMARA WR		101	S		0	3.09	365	0.0	I
CANYON FARM	1-5-3	302	S		0	12.82	365	0.0	I
CHANDLER F&E	5-8-4:1,4	205	S		5555	0.00	365	6.0	I
CHAR B		303	S		0	49.32	365	5.0	I
CITIZEN'S UTIL		101	W			3600.00	365		D
COFFMAN R	2-5-2:07	101	S		5	0.53	365	3.5	I
DANIELS M&D	4-9-12:11	104	S		0	0.50	365	0.0	I
DAWA	5-5-6:22	202	S		8194	0.00	365	1.8	I
DELA TORRE	1-3-1:115	301	W		25	3.00	365	0.7	I
DOIRON EP	5-8-5:27	203	S		5556	0.00	365	1.7	I
DOIRON EP	5-8-5:33	203	S		65278	0.00	365	0.3	I
DUNN JA	5-9-6:12	203	S		0	4.70	365	0.8	I
DUSENBERRY CW	1-5-2:20	302	S		2513	0.00	365	0.3	I
DYRE BA	4-5-2:1-3	202	S		1736	0.00	0	0.0	I
E&F FARMING	5-2-2:13C	201	S		700	12.00	365	25.0	I
FLEMING WR	5-1-4:2	105	W		5	0.38	365	0.0	I
GANEKO M	1-3-1	101	W		0	30.00	365	0.5	I
GAY & ROBINSON	1-8-1:1	101	S		0	300.00	365	0.0	I
GAY & ROBINSON	1-5-1:2	302	S		3472	5000.00	365	0.0	I
GAY & ROBINSON		303	S		0	40000.00	365	0.0	I
GAY & ROBINSON	1-7-2:3	303	S		3472	5000.00	365	0.0	I
GAY & ROBINSON	1-7-2:3	303	S		347	500.00	365	0.0	I
GAY & ROBINSON	1-7-2:3	303	S		694	0.00	365	0.0	I
GAY & ROBINSON	1-8-4:3	304	S		2083	3000.00	365	0.0	I
GOO R	4-6-11	104	S		217	0.00	365	25.0	I

GORDON L&J	2-4-1:47	101	S		50	0.00	0	1.0 I
GROVE FARM	2-9-3:5	101	W		50	0.00	8	0.0 I
HALE KAUAI LTD	4-3-2:5-12	104	S		100	2.47	365	0.0 I
HANALEI LAND	4-5-5:1-2	104	S		0	3287.67	365	75.0 I
HANWRIGHT J	4-9-11:23	104	W		10	0.51	365	0.0 I
HARAGUCHI FARM	5-4-3:7	202	S		5139	0.00	365	5.0 K
HARAGUCHI FARM	5-4-3:7	202	S		5139	0.00	365	47.0 K
HARAGUCHI I		202	S		200	98.63	365	6.8 I
HARAGUCHI T	5-4-3:1	202	S		2693	0.00	365	6.6 I
HAUMEA J	5-8-4:18	203	S		0	0.00	365	1.5 K
HAUMEA J	5-8-7:12	203	S		1250	0.00	365	5.4 K
HAUMEA JK		203	S		0	0.00	365	2.0 K
HAUPU RANCH	2-9-3:4-10	101	W		25	1.25	365	648.5 I
HAWAIIAN FARMER	5-6-4:7	202	S		10417	0.00	365	80.0 I
HAWAIIAN TRUST	4-9-6:5	104	W	1019-03	25	8.00	365	10.0 I
HICKEY S	5-8-5	203	S		0	100.00	365	2.0 I
HIYANE G		104	S		0	16.44	365	5.0 I
HOLI G	4-3-8:5-4	102	S		0	0.00	365	6.7 K
HOLI OK	2-9-2:	101	S		0	0.00	0	0.0 K
HOP HING CO	2-5-4:2	101	S		3472222	0.01	365	2.0 I
HORNER D		304	W		50	5.00	30	0.0 I
HYDE RICE	3-1-3	102	W	5625-01	90	0.00	365	0.0 I
ISHIKAWA K	5-6-3:2	202	S		965	0.00	0	10.0 I
JACK M	1-7-3:16	303	S		4488	0.00	365	1.0 I
KAAKAANIU PLNT	4-9-12:	104	W		0	3.29	365	0.0 I
KAHILI ADV SCH	2-7-13:396	101	W		0	0.33	365	5.0 I
KAHILI FARM	5-2-2:10	105	S		0	0.00	0	0.0 I
KAJIWARA MI	1-6-2:10	302	S		347	0.00	365	0.0 I
KAKIMOTO H	4-9-2:16	104	W	0919-02	8	0.00	365	1.0 I
KANEHE HP	5-8-4:20	203	S		5520	8000.00	365	0.0 I
KANEKUNI K	1-3-1:128	301	W		16	5.00	365	0.0 I
KANEKUNI S	1-3-1:253	301	W		10	0.00	365	0.3 I
KANESHIRO FARMS	2-7-5:12	101	W		15	11.00	365	0.0 I
KAOHI AG	1-5-2:27	302	S		0	0.00	0	0.1 K
KAOHI AG	1-5-3:26	302	S		0	0.00	0	4.0 K
KAOHI AG	1-6-1:20	302	S		0	0.00	0	0.5 K
KAOHI AG	1-6-1:23	302	S		0	0.00	0	0.9 K
KAOHI AG	1-6-2:23	302	S		0	0.00	0	6.3 K
KAOHI AG	1-6-2:26	302	S		0	0.00	0	1.4 K
KAOHI AG	1-6-2:30	302	S		0	0.00	0	2.6 K
KAOHI AG	1-6-2:38	302	S		0	0.00	0	0.5 K
KAOHI AG	1-6-2:39	302	S		0	0.00	0	0.2 K
KAOHI AG	1-6-2:40	302	S		0	0.00	0	0.3 K
KAOHI AG	1-7-4:1	302	S		0	0.00	0	2.0 K
KAOHI AG	1-7-4:3	302	S		0	0.00	0	1.6 K
KAOHI AG	1-7-4:8	302	S		0	0.00	0	2.0 K
KAOHI L	1-9-2:5	304	S		0	0.00	365	2.9 K
KAONA FARMS	5-5-6:2	202	S		76296	0.00	365	0.2 I
KAONA FARMS	5-5-6:22	202	S		76296	0.00	365	0.3 I
KAONA FARMS	5-5-6:5	202	S		100980	0.00	365	0.4 I
KAONA FARMS	5-5-6:6	202	S		51163	0.00	365	1.2 I
KAONA FARMS	5-5-6:7	202	S		299350	0.00	365	0.9 I
KAONA FARMS	5-5-7:21	202	S		51163	0.00	365	0.3 I
KAPAHI SL HOUSE	4-4-13:28	104	S		0	1434.70	365	34.6 I
KAPAKA ARBOLEDA	4-3-3:1-2	104	S		0	200.00	365	2.1 I
KAUAI HILTON	3-7-3:1	102	W		0	7.40	365	0.0 I
KAUAI INT FARMS	4-3-3:3-1	102	S		500	720.00	365	4.0 I
KAUAI INT FARMS	4-3-3:3-1	102	S		500	720.00	365	4.0 I
KAUAI WATER CO	4-3-1:1,2	102	W		0	3.29	365	0.0 I
KAUAI WATER CO	4-3-1:9,10	102	W		0	3.29	365	0.0 I

KEAT TRUST	4-9-10:1	104 W	1020-03	0	187.50	365	0.0	I
KEAT TRUST	4-9-10:1	104 S		0	0.00	0	108.0	I
KEAT TRUST	4-9-10:3	104 S		0	0.00	0	47.0	I
KEAT TRUST	4-9-11:13	104 S		0	0.00	0	216.0	I
KEAT TRUST	4-9-11:5	104 S		0	0.00	0	35.0	I
KEAT TRUST	5-1-2:2	104 S		0	0.00	0	71.3	I
KEAT TRUST	5-8-5:15	104 S		0	0.00	0	1.1	I
KEKAHA PLANT	1-5-2:48	302 S		2513	0.00	365	0.6	K
KEKAHA PLANT	1-5-2:49	302 S		2513	0.00	365	0.3	K
KEKAHA SUGAR		301 W		0	18260.00	365	8366.0	W
KEKAHA SUGAR		301 S		0	52000.00	365	0.0	U
KEKAHA SUGAR		301 W			18260.00	365		U
KEKAHA SUGAR		302 S		0	52000.00	365	0.0	W
KIAHUNA GOLF	2-8-14	101 S		0	250.00	365	140.0	I
KIAHUNA GOLF	2-8-14	101 W		120	115.20	91	0.0	I
KIAHUNA GOLF	2-8-14	101 W		140	134.10	91	0.0	I
KIAHUNA GOLF	2-8-14	101 W		140	134.10	91	0.0	I
KIAHUNA GOLF	2-8-14	101 W		60	57.60	91	0.0	I
KIAHUNA PLANT		101 W	5227-01	50	51.00	4	0.0	I
KIKIAOLA LAND	1-4-3:12	302 S		50	0.00	365	2.0	I
KILAUEA AGRON	5-2-1:3	105 S		0	1424.66	365	271.0	I
KILAUEA AGRON	5-2-2:12	105 S		0	1819.18	365	225.0	I
KILAUEA AGRON.	5-2-2-10	105 S			2700.00	365	.	I
KILAUEA MANAGE	5-1-5:3	105 S		0	75.34	365	60.0	I
KILAUEA WATER	5-2-2:13	105 S		100	4.70	365	12.1	I
KIPUKAI RANCH	3-1-1:3	102 W	5523-01	70	7.40	365	21.0	I
KIPUKAI RANCH	3-1-1:3	102 S		25	11.80	365	0.0	I
KIPUKAI RANCH	3-1-1:3	102 W	5523-02	300	200.00	365	137.0	I
KIRKWOOD J	5-1-3:6	104 S		69	164.40	365	0.0	I
KOBASHIGAWA N	1-3-1:45	301 W		12	4.00	365	0.0	I
KOBAYASHI H	5-5-6:9	202 S		50714	0.00	0	13.0	K
KOBAYASHI H	5-6-2:2	202 S		0	0.00	0	116.0	K
LIHUE PLANT	HANAMAULU	102 W	0020-01	0	187.50	365	0.0	I
LIHUE PLANT	HANAMAULU	102 S		0	15699.19	365	0.0	I
LIHUE PLANT	LIHUE MILL	102 S		0	32.88	365	0.0	I
LIHUE PLANT	UPPER LIHU	102 S		0	8383.02	365	0.0	I
LIHUE PLANT	16069000	103 S		0	10284.93	365	0.0	W
LIHUE PLANT	16100000	103 S		0	17460.27	365	0.0	U
LIHUE PLANT	HANAMAULU	103 S		0	19739.17	365	0.0	I
LIHUE PLANT	UPPER LIHU	103 S		0	10540.27	365	0.0	I
LIHUE PLANT	16069000	104 S		0	10284.93	365	0.0	U
LIHUE PLANT	16077000	104 S		0	4498.63	365	0.0	I
LIHUE PLANT	16079000	104 S		0	3981.04	365	0.0	I
LIHUE PLANT	16088000	104 S		0	3471.23	365	0.0	I
LIHUE PLANT	16091000	104 S		0	1767.12	365	0.0	I
LIHUE PLANT	4-7-1:1	104 S		0	4437.18	365	0.0	I
LIHUE PLANT	4-7-1:1	104 S		0	4437.18	365	0.0	I
LIHUE PLANT	4-7-1:1	104 S		0	6482.52	365	0.0	I
LIHUE PLANT	4-7-1:1	104 S		0	6482.52	365	0.0	I
LIHUE PLANT	KAPAA SHAF	104 W	0419-02	0	187.50	365	0.0	I
LIHUE PLANT	KAPAA W	104 W	0419-03	0	187.50	365	0.0	I
LIHUE PLANT	KEALIA # 1	104 W		0	23.86	365	0.0	I
LIHUE PLANT	KEALIA # 2	104 W		0	23.86	365	0.0	I
LIHUE PLANT	KEALIA DIT	104 S		0	5841.10	365	0.0	I
LIHUE PLANT	KEALIA DIT	104 W		0	5841.10	365	0.0	I
LIHUE PLANT	MOLOAA # 1	104 W		0	35.62	365	0.0	I
LIHUE PLANT	MOLOAA # 2	104 W		0	175.34	365	0.0	I
LIHUE PLANT	16100000	202 S		0	17460.27	365	0.0	W
MAHELONA J	3-8-6:2	102 S		0	3.86	365	5.9	K
MAHUIKI S	5-9-5:57	203 S		20	0.00	365	1.3	I

MANA SHAFT	1-2-2:1	301	W	0245-02	2200	509.59	365	100.0 I
MARTIN	1-3-1:97	301	W		25	0.00	105	0.2 K
MARTINO P & L	4-9-11:7	104	W		10	2.50	365	1.3 I
MASADA FARM	5-5-6:8	202	S		417	0.00	365	3.5 K
MAYNARD	5-3-7:2,3	201	S		0	0.00	365	1.0 K
MCBRYDE	2-1-01:10	101	W	5534-	1100	103.42	365	10.0 I
MCBRYDE	2-1-1:10	101	W	5534-01	24600	15683.29	365	2562.0 U
MCBRYDE	2-1-1:10	101	S		34722	11264.93	365	2562.0 U
MCBRYDE	2-4-09:01	101	S		565278	7175.34	365	1628.0 I
MCBRYDE	2-5-02:18	101	S		13889	1739.45	365	1003.0 I
MCBRYDE	2-5-04:61	101	W	5530-	1100	1130.41	365	1000.0 I
MCBRYDE	2-5-10:43	101	W	5529-01	3500	3158.08	365	550.0 I
MCBRYDE	2-7-02:01	101	S		27778	2558.90	365	150.0 I
MCBRYDE	2-8-01-01	101	W	5527-01	3750	530.41	365	0.0 I
MCBRYDE	2-8-01:01	101	H			17088.22	365	1592.0 U
MCBRYDE	2-8-01:02	101	W	5628-01	3750	2000.00	365	1593.0 I
MCBRYDE	2-9-02-01	101	W	5426-03	4000	2295.07	365	374.0 I
MCBRYDE	2-9-02:01	101	W	5526-01	4000	293.70	365	1593.0 I
MCBRYDE	2-9-03:01	101	W	5425-11	900	643.01	365	136.0 I
MCBRYDE	3-4-01:01	101	S		6944	5227.12	365	281.0 U
MCBRYDE	2-8-01:01	102	H		0	17088.22	365	1592.0 W
MCBRYDE	3-4-01:01	102	S		6944	5227.12	365	281.0 W
MCBRYDE	2-1-01:10	304	W	5534-01	24600	15683.29	365	2562.0 W
MCBRYDE	2-1-01:10	304	S		34722	11264.93	365	2562.0 W
MCBRYDE P.PLANT	5-8-01:01	203	S		224400	53892.89	365	0.0 D
MEDEIROS FARM	3-4-1:2	102	S		30	327.00	365	0.0 I
MIIKE D	5-4-3:1	202	S		2244	0.00	365	7.9 I
MOORE MM	5-9-3:40	203	S		40	0.08	365	6.0 I
MORIARTY D	4-9-2:5	104	W	0919-01	7	4.93	365	15.0 I
MOWRY	5-4-4:10	202	W		100	0.14	365	0.0 I
NAMAHANA FARMS	5-2-1:3	201	S		100	0.00	365	0.0 I
NAMAHANA FARMS	5-2-1:3	201	S		160	0.00	365	0.0 I
NAT TROP BOT GA	5-9-1:3	203	S		100	1.32	365	0.0 I
NAT TROP BOT GA	5-9-1:3	203	S		100	144.00	365	0.0 I
NAT TROP BOT GA	5-9-6:9	203	S		200	0.80	365	0.0 I
NISHIMOTO	4-5-8:4-23	104	S		0	0.00	365	1587.0 K
NISHIMOTO	4-5-8:4-26	104	S		0	230.00	365	6.1 I
NISHIMOTO	4-5-8:4-26	104	S		0	0.00	365	1.6 K
NISHIMOTO	4-5-8:4-27	104	S		0	0.00	365	3.6 K
NONAKA FARM	1-9-1:14-1	304	P		0	20.00	365	0.0 I
NORTHRUP KING	1-2-2:1	301	W		1100	301.37	365	80.0 I
NORTHRUP KING	1-5-1:1	302	S		800	15.62	365	2.5 I
NORTHRUP KING	1-5-3:1	302	S		800	18.90	365	3.0 I
NORTHRUP KING	1-5-3:3	302	S		800	98.63	365	15.9 I
NORTHRUP KING	1-7-4:7	303	S		800	28.27	364	4.5 I
O THRONAS	2-5-4:5	101	S		0	0.11	365	0.0 I
OHANA	5-1-5:15	105	S		0	864.00	365	10.0 I
OLOKELE (DMSC.)		303	W			215.00	365	D
OLOKELE SUGAR	1-7-6:4	303	W	5635-02	0	942.38	365	0.0 I
OLOKELE SUGAR	1-7-6:4	303	W	5635-01	0	1202.89	365	0.0 I
OLOKELE SUGAR	1-7-6:4	303	S		0	29500.00	365	0.0 U
OLOKELE SUGAR	1-7-6:4	303	S		0	3500.00	365	0.0 W
OLOKELE SUGAR	1-7-6:4	303	S		0	2500.00	365	0.0 I
OLOKELE SUGAR	1-7-6:4	304	S		0	500.00	365	0.0 I
OLOKELE SUGAR	1-7-6:4	304	S		0	29500.00	365	0.0 W
OLOKELE SUGAR	1-7-6:4	304	S		0	3500.00	365	0.0 U
OP GARD & PLANT	2-7-7:4	101	W		0	29.50	365	12.3 I
OSHITA JK	4-8-1:17	104	W		0	2.25	365	1.0 I
PACIFIC HYDROEL	4-5-3-1:9	104	S		120	36.00	365	0.0 I
PIONEER	1-2-2:	301	S		0	525.00	365	35.0 I

PIONEER	1-5-2:	302	S		0	345.00	365	23.0 I
PIONEER	1-6-2:	302	S		0	285.00	365	19.0 I
PRINCEVILLE		201	W		1500	514.29	365	0.0 N
PRINCEVILLE	4-5-3-1-14	201	W		1500	779.22	365	. M
PRINCEVILLE	5-3-6-14	201	S		694	91.78	365	I
PRINCEVILLE		202	W		1500	264.94	365	0.0 N
REIS JM	1-3-1:54	301	W		25	1.50	105	0.3 I
REYES J	5-5-6:3	202	S		0	0.00	365	2.1 K
RYDER	3-8-5:5	102	S		75	1.05	365	1.0 I
SANTOS HM	5-8-4:8	203	S		65278	0.00	0	1.5 I
SCHAEFER B	5-2-13:10	201	S		10	1.10	365	8.0 I
SCHENKER SR	4-9-11:17	104	W		8	1.23	365	1.0 I
SHIMAOKA T	1-3-4:18	301	S		12	0.00	365	0.0 I
SHIRAKI YI	4-9-4:1	104	W	0918-01	0	0.68	365	4.0 I
SMITH BM	1-5-2:46	302	S		2512	0.00	365	0.5 K
SPENCER CHK	4-5-5:6	202	S		70	0.00	365	0.0 I
SPENCER CHK	5-4-3:7	202	S		1211	0.00	365	7.0 I
STORM J	2-8-4:48	101	W		4	1.20	365	0.0 I
STRIEGEL R&K	5-6-4:8	202	S		0	125.00	365	1.3 I
SUNRISE FARMS	4-9-11:21	104	W		10	1.53	365	8.0 I
SUNRISE FARMS	4-9-11:21	104	W		8	1.12	365	3.0 I
SUSSMAN M	4-8-4:3	104	S		0	120.00	365	1.8 I
TAI HOOK W	5-4-3:1	202	S		1391	83.48	365	12.0 I
TAI HOOK W	5-4-3:7	202	S		1616	96.94	365	7.0 I
TAI HOOK W	5-8-6:19	203	S		3590	0.00	0	3.0 I
TAI HOOK W	5-8-7:14	203	S		5385	0.00	0	7.0 I
TANIGUCHI E	1-7-2:3	303	S		4488	0.00	365	2.2 K
TANIGUCHI E	1-7-2:3	303	S		4488	0.00	365	8.5 K
TASAKA B	5-5-9:6	202	S		528	0.00	0	4.7 I
TASAKA B	5-5-9:6	202	S		389	0.00	0	4.8 I
THOMPSOM JD	5-1-0	105	S		943	0.00	365	0.8 K
THRONAS H	4-9-5:7	104	S		0	0.05	91	9.6 I
TOMOMITSU J	1-3-1:32	301	W		15	0.00	365	0.8 I
TYCO TARO FARM	1-7-2:3	302	S		4488	0.00	0	6.5 K
UH TROP AG		103	S		0	328.77	365	7.0 I
UH TROP AG		103	S		0	13000.00	365	20.0 I
UNSENBERRY FD	1-5-3:8	302	S		150	0.00	0	0.0 I
UYENO D	1-3-1:49	301	W		3	87.67	365	0.0 I
WARTHER FX	1-4-4:1,2	301	S		3	4.32	365	0.5 I
WARTHER FX	1-4-4:3,9	301	S		3	4.32	365	0.5 I
WATARI H	5-4-3	202	S		9375	5142.96	365	1.3 I
WATARI H	5-5-6:1	202	S		9375	399.10	365	1.0 I
WATARI H	5-5-7:10	202	S		9375	275.66	365	0.7 I
WATARI H	5-5-7:11	202	S		9375	106.98	365	0.3 I
WATARI H	5-5-7:12	202	S		9375	49.38	365	0.1 I
WATARI H	5-5-7:13	202	S		9375	436.12	365	1.1 I
WATARI H	5-5-7:14	202	S		9375	135.78	365	0.3 I
WATARI H	5-5-7:15	202	S		9375	277.72	365	0.7 I
WATARI H	5-5-7:16	202	S		9375	65.84	365	0.2 I
WATARI H	5-5-7:17	202	S		9375	1839.12	365	4.5 I
WATARI H	5-5-7:18	202	S		9375	189.27	365	0.5 I
WATARI H	5-5-7:3	202	S		9375	259.34	365	0.6 I
WATARI H	5-5-7:30	202	S		9375	136.44	365	0.3 I
WATARI H	5-5-7:31	202	S		9375	266.87	365	0.6 I
WATARI H	5-5-7:4	202	S		9375	246.46	365	0.6 I
WATARI H	5-5-7:5	202	S		9375	259.21	365	0.6 I
WATARI H	5-5-7:6	202	S		9375	345.61	365	0.8 I
WATARI H	5-5-7:7	202	S		9375	168.70	365	0.4 I
WATARI H	5-5-7:9	202	S		9375	148.12	365	0.4 I
WATARI H	5-6-2:12	202	S		9375	2000.00	365	5.7 I

WESTERN SKIES	5-2-13:5	105	S	65	6.50	183	13.0 I
WESTIN HOTELS	3-5-1:27	102	W	200	87.50	365	97.0 I
WESTIN HOTELS	3-5-1:27	102	W	200	87.50	365	97.0 I
WESTIN HOTELS	3-5-1:27	102	W	350	300.00	365	97.0 I
WESTIN HOTELS	3-5-1:27	102	W	350	300.00	365	97.0 I
WESTIN HOTELS	3-5-1:27	102	W	400	300.00	365	97.0 I
WICHMAN CR	5-9-1:3	203	P	0	43.26	365	0.0 I
WILLIAMSON HD	1-4-3:15	202	S	20	0.00	0	0.0 I
ZABLAN LN	4-9-12:7,9	104	S	0	0.00	0	1.0 K
ZABLAN LN	4-9-13:3	104	S	0	0.00	0	0.2 K
ZABLAN LN	5-1-3:7	105	S	0	0.00	0	0.0 K
ZABLAN LN	5-2-10:	201	S	0	0.00	0	0.0 K

Table A-19

KAUAI WATER STUDY 03-Dec-89
1-15409-0E MUNICIPAL WATER DEMAND

ZONE	USER CLASS	CONSUMPTION (1000 GALLONS/YEAR) REGULAR	CLOSING/LATE/ADD	TOTAL
1101		0	0	0
		0	0	0
1102	10	39,392	292	39,684
		39,392	292	39,684
1103	10	43,331	131	43,462
	30	27	0	27
	40	3,739	0	3,739
	50	84	79	163
	61	15,166	0	15,166
	63	5,670	0	5,670
	65	4,865	0	4,865
	70	269	0	269
	80	1,463	0	1,463
		74,614	210	74,824
1104	10	28,699	43	28,742
	20	35,917	0	35,917
	30	2,776	0	2,776
	50	0	0	0
	70	280	0	280
	80	2,583	0	2,583
		70,255	43	70,298
1105		0	0	0
		0	0	0
1106	10	53,467	233	53,700
	30	970	0	970
	50	0	0	0
	70	1,095	0	1,095
	80	532	0	532
		56,064	233	56,297
1201	10	81	0	81

	20	1,907	0	1,907
	63	840	0	840
	65	1,161	0	1,161
	70	16,464	0	16,464
		20,453	0	20,453
1202		0	0	0
		0	0	0
1203		0	0	0
		0	0	0
1204	10	2,167	0	2,167
	20	7,672	0	7,672
	30	799	0	799
	50	1,816	0	1,816
	63	5,889	0	5,889
	65	15,740	0	15,740
	80	787	0	787
		34,870	0	34,870
1205	00	0	0	0
	10	20,476	104	20,580
	30	1,513	0	1,513
	70	1,980	34	2,014
	80	437	0	437
		24,406	138	24,544
1206	10	2,866	0	2,866
		2,866	0	2,866
1207	10	9,379	14	9,393
	20	7,179	0	7,179
	30	12,930	87	13,017
	63	24,814	0	24,814
	65	15,179	0	15,179
	70	735	0	735
	80	0	0	0
		70,216	101	70,317
1208	10	30,478	196	30,674
	20	238	0	238

	30	185	0	185
	50	456	0	456
	65	109	0	109
	70	1,848	0	1,848
	80	1,821	0	1,821
		35,135	196	35,331
1301		0	0	0
		0	0	0
1302	10	23,799	79	23,878
	65	213	0	213
	70	284	0	284
		24,296	79	24,375
1303	10	7,584	64	7,648
	65	688	0	688
	70	498	0	498
		8,770	64	8,834
1304	00	0	0	0
	10	15,712	118	15,830
	20	4,705	0	4,705
	30	16,913	94	17,007
	50	308	0	308
	62	10	0	10
	63	1,035	0	1,035
	65	12,496	0	12,496
	70	6,086	0	6,086
	80	1,356	0	1,356
		58,621	212	58,833
1305	10	7,762	116	7,878
	20	576	0	576
	30	361	0	361
	50	74	0	74
	70	2,410	0	2,410
	80	189	0	189
		11,372	116	11,488
1306		0	0	0
		0	0	0

1307	10	53,235	120	53,355
	20	18,665	3,634	22,299
	63	8,729		8,729
	65	670		670
	70	976		976
	80	805		805
		83,080	3,754	86,834
TOTAL ZONE 1		614,410	5,438	619,848
2101	03	85	26	111
	10	8,000	0	8,000
	30	628	0	628
	70	3,635	0	3,635
		12,348	26	12,374
2102	10	28,946	226	29,172
	20	1,986	0	1,986
	30	942	35	977
	50	406	0	406
	65	211	0	211
	70	5,168	13	5,181
	80	252	0	252
		37,911	274	38,185
2103	10	3,118	34	3,152
	30	0	0	0
	70	947	0	947
		4,065	34	4,099
2104	10	48,961	395	49,356
	20	5,986	0	5,986
	30	1,966	1	1,967
	40	3,036	0	3,036
	50	358	27	385
	63	2,716	0	2,716
	65	4,569	0	4,569
	70	2,542	0	2,542
	80	1,408	0	1,408
		71,542	423	71,965
2105	10	27,460	258	27,718
	30	699	0	699

	70	7,721	0	7,721
		35,880	258	36,138
2106	10	2,348	0	2,348
	30	311	0	311
	70	4,112	7	4,119
		6,771	7	6,778
2201	10	17,609	122	17,731
	30	3,969	0	3,969
	70	2,183	0	2,183
	80	57	0	57
		23,818	122	23,940
2202	10	30,652	149	30,801
	20	64	0	64
	30	2,402	0	2,402
	65	5	0	5
	70	1,565	0	1,565
	80	153	0	153
		34,841	149	34,990
2203	10	4,324	19	4,343
	70	1,065	0	1,065
		5,389	19	5,408
2204	00	0	0	0
	10	34,595	215	34,810
	20	378	0	378
	30	2	0	2
	70	6,833	0	6,833
	80	494	0	494
		42,302	215	42,517
2231	50	3,803	54	3,857
		3,803	54	3,857
2301	10	776	0	776
	62	101	0	101
	65	632	0	632
		1,509	0	1,509

2302	10	19,614	213	19,827
	20	4,287	305	4,592
	30	6,948	0	6,948
	50	0	74	74
	65	130	0	130
	80	277	0	277
		31,256	592	31,848
2303	10	18,176	53	18,229
	20	3,640	0	3,640
	30	1,354	0	1,354
	65	40	0	40
	70	388	0	388
	80	168	0	168
		23,766	53	23,819
2304	00	0	0	0
	10	17,084	96	17,180
	20	543	0	543
	30	20,040	8	20,048
	40	1,905	0	1,905
	50	0	0	0
	63	3,204	0	3,204
	70	112	0	112
	80	1,210	0	1,210
		44,098	104	44,202
2401	00	0	0	0
	10	22,375	36	22,411
	20	21,688	0	21,688
	30	2,380	0	2,380
	40	15,615	475	16,090
	50	200	0	200
	63	204	0	204
	65	1,784	0	1,784
		64,246	511	64,757
2402	10	1,683	0	1,683
	30	410	0	410
	70	60	0	60
		2,153	0	2,153
2403	00	0	0	0
	10	15,530	13	15,543

	30	19,298	469	19,767
		34,828	482	35,310
2404	00	0	0	0
	10	3,678	47	3,725
	20	78,916	1,084	80,000
	30	20,398	0	20,398
	40	135,254	4,513	139,767
	50	13,119	0	13,119
	65	3,163	0	3,163
	70	11	0	11
		254,539	5,644	260,183
2405	00	0	0	0
	10	49,249	788	50,037
	20	101,890	14	101,904
	30	7,747	0	7,747
	40	909	0	909
	50	4,733	0	4,733
	62	1,042	0	1,042
	65	23	0	23
		165,593	802	166,395
TOTAL ZONE 2		900,658	9,769	910,427
3101	00	0	0	0
	10	34,671	85	34,756
	20	325	0	325
	30	1,221	5	1,226
	40	6,123	0	6,123
	50	5,982	0	5,982
	63	5,488	0	5,488
	65	106	0	106
	70	1,817	0	1,817
		55,733	90	55,823
3102	00	0	0	0
	10	467	0	467
	30	4,710	0	4,710
	70	7,476	0	7,476
		12,653	0	12,653
3201	10	4,591	7	4,598
	30	439	0	439

	50	1,784	0	1,784
	62	154	0	154
	63	560	0	560
	65	235	0	235
	70	644	0	644
	80	338	0	338
		8,745	7	8,752
3202	00	0	0	0
	10	60	0	60
	30	23,629	146	23,775
		23,689	146	23,835
3203	10	29,340	122	29,462
	20	31	0	31
	30	0	0	0
	50	0	32	32
	65	0	0	0
	70	128	0	128
	80	0	0	0
		29,499	154	29,653
3204	10	11,711	75	11,786
	20	444	0	444
	30	312	22	334
	40	1,256	0	1,256
	50	6,892	0	6,892
	63	21,321	0	21,321
		41,936	97	42,033
3205	00	0	0	0
	10	5,387	84	5,471
	20	12,496	0	12,496
	30	11,963	0	11,963
	40	163,238	0	163,238
	50	449	1	450
	61	50	8	58
	63	14,511	0	14,511
	65	1,778	0	1,778
	80	143	0	143
		210,015	93	210,108
3206	10	29,790	145	29,935
	30	163	0	163
	70	35	0	35

		29,988	145	30,133
3207	00	0	0	0
	30	15,949	140	16,089
	50	39,029	720	39,749
	65	2,855	0	2,855
		57,833	860	58,693
3208	63	29,372	0	29,372
		29,372	0	29,372
3209	10	35,850	169	36,019
	20	2,665	0	2,665
	30	8,787	58	8,845
	50	44	0	44
	63	45,117	0	45,117
	65	87	0	87
	80	2,519	0	2,519
		95,069	227	95,296
3210	00	0	0	0
	10	7,569	44	7,613
	20	20,340	0	20,340
	30	33,673	233	33,906
	40	2,236	0	2,236
	50	5	4	9
	62	140	0	140
	63	8,702	0	8,702
	65	4,281	0	4,281
	80	1,315	0	1,315
		78,261	281	78,542
3211	00	0	0	0
	10	27,221	88	27,309
	20	4,704	0	4,704
	30	9,152	5	9,157
	50	7,647	0	7,647
	65	381	0	381
	70	1,537	0	1,537
	80	980	0	980
		51,622	93	51,715
3212	10	930	8	938
	20	8,427	0	8,427
	30	15,865	0	15,865

		25,222	8	25,230
3213	00	0	0	0
	10	3,625	17	3,642
	30	948	17	965
	50	982	0	982
	65	125	0	125
	70	34	0	34
	80	1,539	0	1,539
		7,253	34	7,287
3214	10	40,230	79	40,309
	30	2,926	0	2,926
	40	4,054	0	4,054
	50	3,919	0	3,919
	63	7,783	0	7,783
	65	2	0	2
	70	348	0	348
		59,262	79	59,341
3215	10	56,764	74	56,838
	20	3,799	0	3,799
	30	503	0	503
	50	1,501	0	1,501
	65	2,684	0	2,684
	70	248	0	248
		65,499	74	65,573
3216	10	8,888	30	8,918
	65	1,216	0	1,216
		10,104	30	10,134
TOTAL ZONE 3		891,755	2,418	894,173
4101	0	0	0	0
	10	40	0	40
	20	29,239	0	29,239
	40	86,185	0	86,185
	50	0	73	73
	63	11,748	136	11,884
	65	12,723	0	12,723
		139,935	209	140,144

4102	00	0	0	0
	10	8,346	116	8,462
	20	35,598	0	35,598
	30	24,603	0	24,603
	40	129,260	0	129,260
	50	414	0	414
	63	749	0	749
	65	489	0	489
	70	134	0	134
	80	294	0	294
		199,887	116	200,003
4103	10	57,447	441	57,888
	30	89	0	89
	63	97	0	97
	65	245	0	245
	70	1,059	0	1,059
		58,937	441	59,378
4104		0	0	0
		0	0	0
4105	10	16,566	122	16,688
	20	14,225	164	14,389
	30	14,936	4	14,940
	50	5	0	5
	62	150	0	150
	63	745	0	745
	65	62	0	62
	80	1,502	0	1,502
		48,191	290	48,481
4106	00	0	0	0
	10	16,174	131	16,305
	20	30,309	43	30,352
	30	11,052	34	11,086
	61	153	0	153
	63	8,597	0	8,597
	65	10,270	0	10,270
	70	833	0	833
	80	858	0	858
		78,246	208	78,454
4107	10	13,044	176	13,220
	20	3,818	0	3,818

	65	293	0	293
	70	1,121	48	1,169
		18,276	224	18,500
4108	10	77,877	873	78,750
	20	7,331	0	7,331
	63	23,940	0	23,940
	65	27	0	27
	70	7,264	12	7,276
	80	1,279	0	1,279
		117,718	885	118,603
4109	00	0	0	0
	10	59,606	413	60,019
	30	4,769	2	4,771
	70	8,341	27	8,368
		72,716	442	73,158
4110	10	6,012	24	6,036
	70	3,071	7	3,078
		9,083	31	9,114
4111	00	0	0	0
	10	19,607	329	19,936
	30	1,050	0	1,050
	65	126	0	126
	70	3,246	8	3,254
		24,029	337	24,366
4112	10	8,342	123	8,465
	30	1,040	0	1,040
	70	1,428	0	1,428
		10,810	123	10,933
4113	10	35,154	403	35,557
	50	666	7	673
	65	221	0	221
	70	6,149	18	6,167
		42,190	428	42,618
4114	10	24,842	303	25,145
	30	1,565	0	1,565

	50	63	0	63
	63	328	0	328
		26,798	303	27,101
4115	10	41,667	720	42,387
	70	1,125	0	1,125
		42,792	720	43,512
4116	10	10,201	120	10,321
	50	35	5	40
	70	1,090	0	1,090
	80	1,473	0	1,473
		12,799	125	12,924
4201	10	21,462	0	21,462
	50	28	0	28
	65	88	0	88
	70	2,337	0	2,337
		23,915	0	23,915
4202	10	13,758	39	13,797
	20	564	0	564
	30	761	0	761
	40	138	0	138
	63	452	0	452
	65	1,097	0	1,097
	70	1,340	0	1,340
	80	108	0	108
		18,218	39	18,257
4203		0	0	0
		0	0	0
4204	10	2,020	6	2,026
		2,020	6	2,026
4205	10	3,294	24	3,318
	70	898	0	898
		4,192	24	4,216

4206	10	94	0	94
	70	773	2	775
		867	2	869
4301	10	314	14	328
		314	14	328
TOTAL ZONE 4		951,933	4,967	956,900
5101	10	3,450	12	3,462
	70	3,664	0	3,664
		7,114	12	7,126
5102	10	2,192	21	2,213
	30	3	0	3
	70	1,577	0	1,577
		3,772	21	3,793
5103	10	3,226	15	3,241
	70	6,524	0	6,524
		9,750	15	9,765
5104	10	49,991	500	50,491
	30	2,236	1	2,237
	50	59	0	59
	63	2,305	0	2,305
	65	1,215	0	1,215
	70	2,885	0	2,885
	80	219	0	219
		58,910	501	59,411
5105	10	1,937	17	1,954
	50	41	79	120
	62	1,908	0	1,908
	70	7,983	10	7,993
		11,869	106	11,975
5106		0	0	0
		0	0	0

5107	10	5,716	8	5,724
	70	3,777	0	3,777
		9,493	8	9,501
5201	10	4,519	26	4,545
	65	755	0	755
	70	37	92	129
		5,311	118	5,429
5301	10	26,610	111	26,721
	20	393	0	393
	30	7,309	0	7,309
	50	14	0	14
	63	440	0	440
	65	2,528	0	2,528
	70	577	0	577
	80	751	0	751
		38,622	111	38,733
5401	10	6,312	54	6,366
	20	17	0	17
	30	161	0	161
	70	810	0	810
		7,300	54	7,354
5402	10	17,892	97	17,989
	20	353	0	353
	40	5,345	0	5,345
	63	0	0	0
	65	1,362	0	1,362
		24,952	97	25,049
5420	10	56	0	56
		56	0	56
5501	(EST)	778	0	778
		778	0	778
TOTAL ZONE 5		177,927	1,043	178,970

GRAND TOTAL	3,536,683	23,635	3,560,318